DownUnder GeoSolutions

Yolla 3D Seismic Survey

Processing Report

Area: Bass Basin Block T/L 1

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Origin Energy Limited

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1 Introduction

The Yolla 3D seismic survey was acquired by Western Geophysical using the seismic vessel M/V WESTERN ATLAS during February and March 1994. The Yolla 3D survey is located offshore Australia in the Bass Basin. It consisted of 13618 line kilometres.
The dataset was processed from SEGY field tape copies (with merged navigation) by DownUnder GeoSolutions in their Perth office from July 2009 to December 2009.

2 Survey Datum

The data was recorded on the AGD-84 datum. The data was processed on this datum up to migration stage. The final processed output data was converted to the GDA94 datum.

Projection:	Universal Transverse Mercator
Zone:	55
Datum:	AGD-84
Central Meridian:	147º East
Scale Factor on Central Meridian:	0.9996
False Northing:	10000000.00N
False Easting:	500000.00E

3 Survey Location

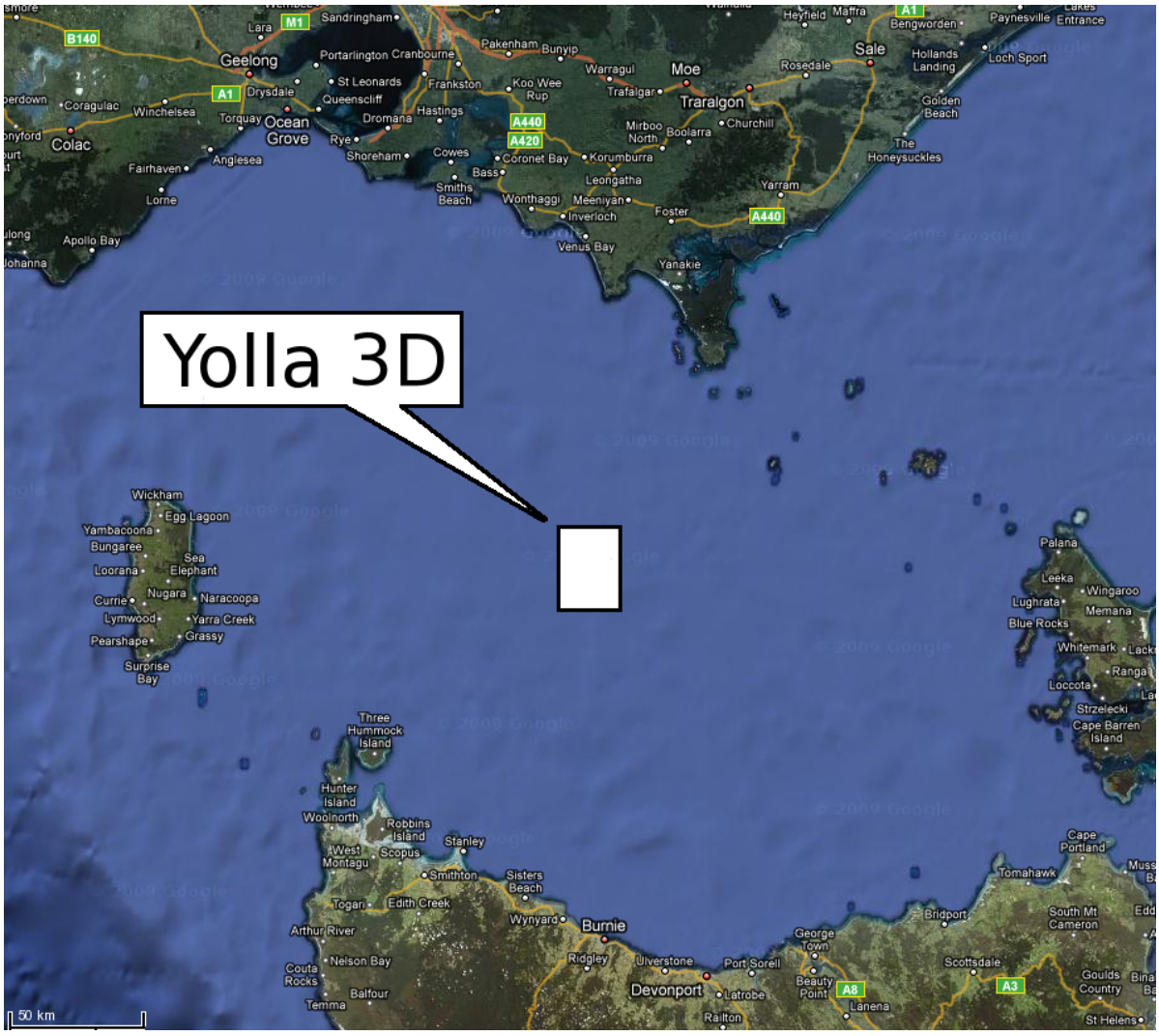


Fig 1: Yolla3D Survey Location

4 Processing Objectives

The goals of the reprocessing were varied and detailed. They were to

1. Optimise the resolution and amplitude preservation at the top EVCM level.
2. Optimise the resolution and amplitude preservation within the Eastern View Coal Measures reservoir section (2458-2973 Sands).
3. Optimise the resolution and amplitude preservation within the Late Cretaceous (TuFl60 Basement).
4. Optimise the resolution and lateral placement of the large and small scale faulting.
5. Optimise the resolution and lateral placement of dykes.
6. Improve resolution of the sill intersected in the Yolla wells.
7. Improve imaging of the volcanics intersected at the base of Yolla 1.

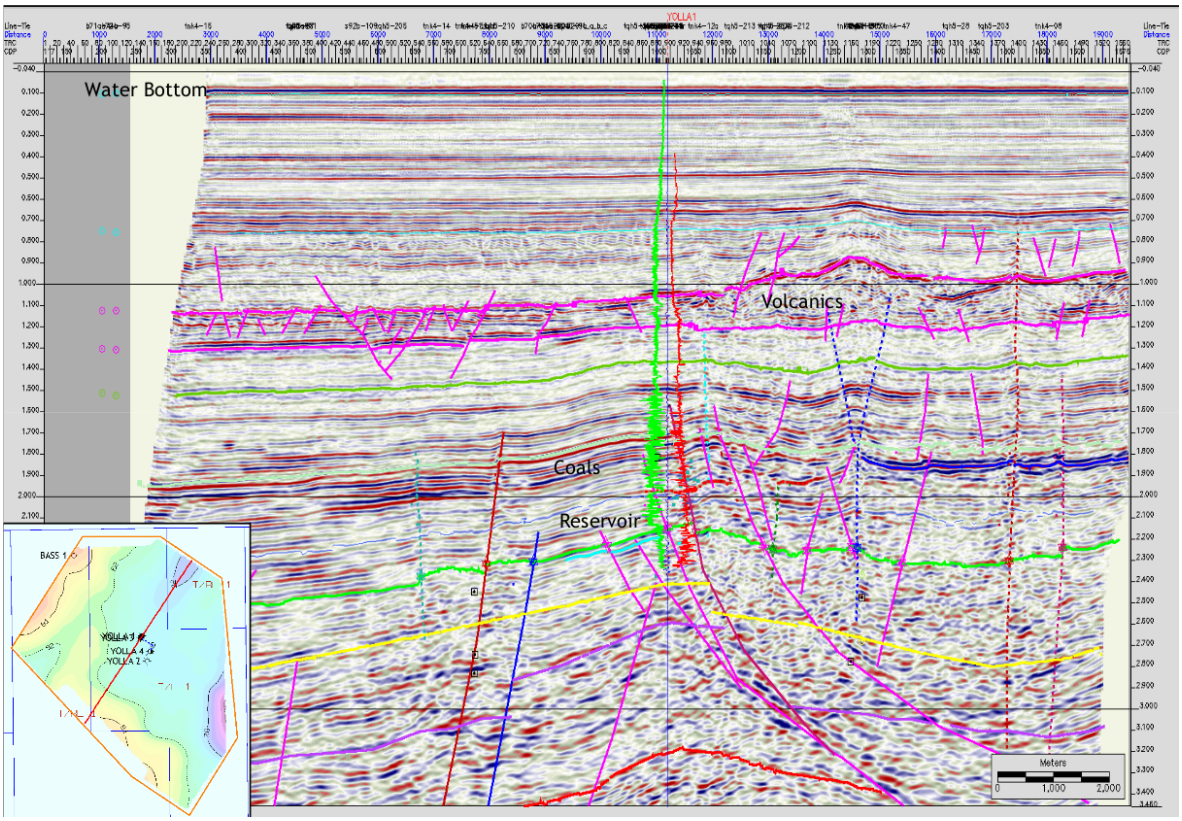


Fig 2: A typical section showing the location of the volcanics, coals and reservoir.

5 Key Personnel

The main personnel involved with the project were:

Origin Energy:

Randall Taylor	Chief Geophysicist
Darren Rutley	Principal Geophysicist

DownUnder GeoSolutions:

Matthew Lamont	Managing Director
Bjorn Muller	Principal Geophysicist
Chris Dinneen	Processing Geophysicist

6 Data Acquisition Parameters

Country of Survey:	Australia
Area of Survey:	Block T/L 1 in the Bass Basin
Data Type:	Marine 3D
Survey Name:	Yolla 3D Seismic Survey
Acquisition Record Length:	6000ms
Acquisition Sample Interval:	2ms
Acquisition Filter Applied:	6/18 [Hz]/[dB/oct] – 196/214 [Hz]/[dB/oct]
Number of Sources:	2
Source Separation:	50m
Shot Interval:	25m
Source Depth:	6m
Streamer Length:	3000m
No. Streamers:	3
Channel Interval:	12.5m
No. Channels:	240 per streamer
Streamer Depth:	10m
Inline Near Offset:	143m

7 Processing Grid Information

7.1 Pre Migration Processing Grid Coordinates (AGD84):

Inline	Crossline	UTM-X	UTM-Z
34	117	402055	5573294
34	1676	412755	5589581
905	1676	394556	5601537
905	117	383856	5585250

7.2 Post Migration Output Grid Coordinates (GDA94):

Inline	Crossline	UTM-X	UTM-Z
34	117	402168.81	5573478.48
34	1676	412868.767	5589765.72
905	1676	394669.620	5601721.71
905	117	383969.663	5585434.473

8 Final Processing Sequence

- Reformat from SEGD to Internal Format
- Tidal Statics
- Source Signature Zero Phasing
- Swell Noise Attenuation
- Shot Point Interpolation to De-alias Multiple Energy
- Dip Filter
- Surface Related Multiple Elimination
- Tau-P Deconvolution and Mute in Tau-P Domain
  - Operator: 600ms
  - Gap: 32ms
- Radon velocity model building
- Pre-Migration Radon demultiple
  - Model: -300 to 2500ms at 3500m
  - Mute: 120 to 2500ms at 3500m
- 2 Iterations of Kirchhoff Depth Migration Velocity Model Building
- Anisotropic parameter fields derivation
- Regularization (DUGREG)
- Tomograpic update (2iterations)
- Full Volume Pre-Stack Kirchhoff Anisotropic Depth Migration
- Post Migration Radon Demultiple
  - Model: -100 to 500ms at 3200m
- Inner and outer trace muting
- Blackman Offset Weighting
- Stack
- Scaling
- Frequency Enhancement

9 Processing

9.1 Data reformat and navigation merge

Data was read from SEGD tapes, reformatted and the geometry information (P1/190) used to update the seismic trace headers.

9.2 Tidal Statics

Tidal variation cause statics shifts between sail lines. These shifts are corrected by calculating static corrections based on tidal tables.

The tidal statics corrections are outlined in the processing test report (pages 7 – 9).

9.3 Source signature zero phasing

The objective of source signature conversion is to convert a far field signature to a more suitable (fit for purpose) signature. This may include a minimum phase wavelet, which is a prerequisite for spiking deconvolution or alternatively a zero phase signature that is more desirable for interpretation and controlled phase processing.

The far field signature can be measured or modelled. A filter is then designed to convert the far field signature to it's zero or minimum phase equivalent without changing the amplitude spectrum of the signature. This filter is then applied to the seismic data. For this dataset the bubble was also removed during the zerophasing process.

See the designature report and the processing test report (pages 3-6) for further detail.

Parameter values:	
Far field signature:	Modelled using source parameters
Desired output phase:	Zero phase
Sample Interval:	2 ms

9.4 Swell noise attenuation

Swell noise is generally caused by rough sea conditions, particularly when the streamers are towed at a shallow depth. Swell noise is removed in the time–frequency domain. The median spectral amplitude within frequency sub-bands is calculated within temporal and spatial windows. If a sample value exceeds a user defined threshold (measured relative to the median value) the sample is interpolated from the adjacent data in the sub-band.

Swell noise attenuation was tested in various domains in an effort to determine if the noise was more randomly distributed in these domains. Swell noise removal in the CDP domain proved very efficient. An added advantage of applying the swell noise attenuation here, was that the events were flat after application of normal moveout correction, which improved the result of interpolating the noisy sub-bands.

Cascaded swell noise removal processes were used, as a single pass was not effective enough at removing all of the swell noise.

See the swell noise attenuation tests in the processing test report.

Time window:	64 ms
Spatial window:	7 traces
Threshold:	500%
Domain:	CDP with NMO applied

9.5 Shot Point Interpolation

Interpolation of extra shot points result in a finer trace spacing in the CDP domain. Multiples and dipping noise with large moveout from near to far traces are usually aliased in the CDP domain due to the sparse sampling. By interpolating shot positions one can de-alias this energy. This is important for any processes that are implemented in this domain, e.g. Radon demultiple and Stacking.

See the processing test report (pages 10 – 15) for further detail.

Parameter values:

Pre interpolation shotpoint spacing :	50.0 m
Post interpolation shotpoint spacing :	12.5 m

9.6 Dip Filtering

Several tests were run to remove the strong dipping noise observed on the shot records. These tests included different velocity cuts applied to shot records with and without normal moveout correction applied. It was found that these filters remove some of the useful diffraction energy in the data. A methodology was therefore derived to try and preserve these diffractions. By performing the filtering in the CDP domain the primary energy can be better protected after normal moveout. However one must also be careful not to remove remove energy that may be needed by subsequent processes e.g. multiples.

See the processing test report (pages 16-24) for further detail.

Parameter values:

Domain of Dip filter application:	CDP with NMO applied
Dips attenuated :	8.22 – 17.0 ms / trace

9.7 Surface Multiple Attenuation (SMA)

Surface multiple attenuation is based on the premise that the seismic data set itself contains all the information required to predict surface multiples. The multiple model is computed via an auto-convolution method of the input data. The resulting multiple model is then adaptively subtracted from the input data.

See the processing test report (pages 38-44) for further detail.

9.8 Tau-P Deconvolution

Deconvolution in the T-X domain is hampered by the aperiodicity of multiple events recorded at non-zero offsets. In the Tau-p domain multiples are periodic for a flat sea floor and can therefore be more effectively removed by deconvolution.

Parameter values:

Gap	32 ms
Operator Length:	600 ms
Design window length:	2000 ms (sliding)
Muting in tau-p domain:	(p-taper : 10 traces Tau-taper : 12 ms)

Tests were run for predictive gaps of 32, 42 and 52 ms and operator lengths of 320 and 600ms. Muting was also applied to remove some residual dipping noise. The mute is tapered in tau and p directions to minimize transform artefacts.

See the processing test report (pages 45-57) for further detail.

9.9 Radon Velocity Model building

A velocity analysis was performed on a 1 x 1km lattice using DUG's Valery velocity picking package. This model was used in the Pre-Migration Radon Demultiple.

See the velocity report for further detail.

9.10 Pre Migration Radon Demultiple

Radon demultiple involves transforming normal moveout corrected common midpoint or image point gathers from X-T domain into the Tau-P domain. The seismic data is modelled with a series of parabolic or hyperbolic curves that are fit to the data using a least squares method. Primary and multiple energy transform to different locations in Tau-P space, which can be exploited to remove unwanted events. The primary energy is normally removed and the multiple energy transformed back to X-T domain and subtracted from the input gathers.

See the radon testing report and the radon update report for further detail.

Parameter values:	
Number of p traces:	300
Model:	-300ms to 2500ms at 3500m
Multiple Model:	120ms to 2500ms
Basis Function:	Hyperbolic

9.11 Gun and cable correction

A gun and cable static correction of 10.6ms was applied to the data to correct it to mean sea level. This was calculated using the following equation:

Static = (Gun depth + Cable depth) / Water velocity

Parameter values:	
Gun Depth:	6m
Streamer Depth:	10m
Water Velocity:	1500m/s
Static Correction:	+10.6m/s

9.12 Kirchhoff Pre Stack Depth Migration

Kirchhoff pre-stack depth migration requires the computation of travel times at every image point in subspace. These travel times are calculated through the wavefront reconstruction method and the maximum energy travel times are utilized. Operator aliasing frequency limits are calculated along the lines of Abma et. al. (1999) and anti-aliasing is implemented as aperture-dependent lowpass temporal filtering of the input data as proposed by Gray (1992). The amplitude maps for true amplitude migration are calculated using a method based on Dellinger et. Al (2000).

The data went through two iterations of velocity model updating. The velocity model was updated via Deregowski loop. Picking events in the deeper part of the data proved very difficult. DUG developed a methodology to improve picking. This was achieved by running full Pre stack depth migrations on the volume using scaled versions of the migration velocity field below 2500m. These output migrations were converted back to time and back to depth using the initial velocity field (unscaled) for the time to depth conversion. The velocity was then picked on stack volumes using DUG's Insight software package.

This updated velocity field was used to derive anisotropic parameters. (see next section)

Parameter values:

	Iteration 1	Iteration 2
Offset Bins	160m-3160m [100m]	370m-3970m [200m]
Aperture	3000m	3000m
Depth Step	5m	3m
Input Grid	25.0m x 6.255m	25.0m x 6.25m
Output Grid	25.0m x 12.5m	25.0m x 12.5m

9.13 Anisotropic pre-stack model building

The proposed flow for the anisotropic pre-stack migration is firstly to use DUG's geostatistical velocity scaling capability. DUG's methodology has provided an approximate tie all wells while producing a stable velocity profile away from wells. The workflow comprises:

1. Migrate using scaled velocity field
2. Pick velocities
3. Calculate anisotropic delta field from velocities picked in step 2 above
4. Migrate 5 times with different epsilon/delta fields (epsilon=1,1.625,2.25,2.875 &3.5)
5. Interpret Epsilon field
6. Migrate with anisotropic velocity field
7. Pick residuals and perform reflection grid tomography
   (Repeat steps 6 and 7 four times)
8. Produce final output

The limited offset range recorded for this data may have been a limiting factor in estimating higher resolution epsilon values for this dataset.

The velocity field derived from the two iterations of "Deregowski loop" was geostatistically scaled using the supplied well information as shown in the velocity model building report.

This geostatistically scaled velocity field was then used to migrate the data. The Delta field was then estimated from the residual moveout picked on these output gathers as shown in the delta field preparation report.

Two passes of tomographic updating were performed on the data as shown in the tomography update report.

9.14 Regularization (DUGREG)

DUGREG is a new seismic regularisation workflow devised by Downunder GeoSolutions.

DUGREG utilises the wave equation to downward continue the seismic data to a set datum, then upward continues it back to the surface. The returned, upward continued data has a trace perfectly positioned at the centre of each (inline/crossline/offset) bin. Azimuth and sampling issues are fully accounted for and it is capable of processing both marine and land data.

During the regularization all traces were input and the regularized data was output on a 25x12.5m grid (see DUGREG velocity report).

9.15 Full Volume Pre Stack Anisotropic Kirchhoff Depth Migration

Parameter values:	
Offset Bins:	370m-6170m [100m]
Aperture:	3000m
Depth Step:	3m
Input Grid:	25.0m x 12.5m
Output Grid:	25.0m x 12.5m

9.16 Post Migration Radon Demultiple

Parameter values:	
Number of p traces:	
Model:	-100ms to 500ms at 3200m
Multiple Model:	50ms to 500ms
Basis Function:	Parabolic
Application starttime:	1500ms

9.17 Muting

An outer trace mute was applied to the data before stacking in order to suppress direct arrivals, refraction energy and NMO stretch. An inner trace mute was applied to suppress remnant multiple.

Inner Mute		Outer Mute	
Time	Offset	Time	Offset
1900	1	0	0
2000	100	4	460
2200	700	450	560
2500	1000	1300	1650
6000	1300	2700	6150

9.18 Offset weighting

After NMO correction the residual move out function of multiples is usually close to a parabola, i.e. proportional to X^2. Suppression of multiples can therefore be obtained by weighting the traces proportional to X rather than using equal weights.
Blackman weights combine this weighting with cosine tapering.

$$W_i = (0.42 + 0.5 \cos \theta_i + 0.08 \cos 2\theta_i)x$$

in which

$$\theta_i = 2\pi [x^2_i - (x^2_{max} + x^2_{min}) / 2] / (x^2_{max} + x^2_{min})$$

This type of weighting was applied to create the fast track stack volume only.

9.19 Stack

The data were stacked using n^1 normalization, where n is the time dependent fold of coverage.

9.20 Angle Stack

Incident angle as a function of time and input velocity (RMS) velocity is calculated for normal moveout corrected CDP gathers. The angles are computed using a curved-ray ray tracing algorithm. The input RMS velocity functions are smoothed before angle calculation. The T-X domain data is then muted along specified angles or converted to angle gathers. Angle stacks are created by stacking the angle muted T-X gathers or the angle gathers.

The smoothed RMS velocities (final migration velocity model) were used for deriving the angles.

Parameter values:

Angle range:	5 to 15 Degrees
Angle range:	15 to 25 Degrees
Angle range:	25 to 35 Degrees
Velocity for angle calculation:	Smoothed RMS function

Intercept and gradient volumes were also derived using the 5-35 degree angle range.

10 Post Stack Processing

10.1 Frequency Enhancement

Frequency enhancement was achieved by applying a linear boost of the amplitudes with increasing frequency. This process is similar to the rho filtering needed to compensate for frequency loss in the slant stacking process. This produced high resolution data without distorting amplitude relationships. Enhancement was applied to 400ms below the supplied EVCM horizon. A taper length of 500ms was used.

10.2 Scaling

The full stack was scaled using a median based scaling method.

Parameter values:	
Temporal window :	1500ms
Spatial window:	301 traces

10.3 Polarity and Phase

No further phase processing was done to the data. The farfield signature was converted to zero phase as the first step in the processing.

Parameter values:	
Polarity data :	Increase in impedance is a negative number (Trough)

11 Conclusion

The derived processing flow resulted in a section with less multiple energy than previous processing attempts. In the deeper section multiple energy was still not completely removed. These multiple may be inter-bed multiples that are not removed by surface multiple attenuation or Radon demultiple.

12 Appendices

12.1 Acquired Lines

Line	Reel	First NavShot	Last Navshot	Sailline Km's	CDP Km's
YOL00001	1shotsegy	292	32	6.5	39
YOL00007	7shotsegy	299	32	6.68	40.05
YOL00013	13shotsegy	307	32	6.88	41.25
YOL00019	19shotsegy	314	32	7.05	42.3
YOL00025	25shotsegy	321	32	7.23	43.35
YOL00031	31shotsegy	329	32	7.43	44.55
YOL00037	37shotsegy	336	32	7.6	45.6
YOL00043	43shotsegy	344	32	7.8	46.8
YOL00049	49shotsegy	351	32	7.98	47.85
YOL00055	55shotsegy	358	32	8.15	48.9
YOL00061	61shotsegy	366	32	8.35	50.1
YOL00067	67shotsegy	373	32	8.53	51.15
YOL00073	73shotsegy	380	32	8.7	52.2
YOL00079	79shotsegy	388	32	8.9	53.4
YOL00085	85shotsegy	395	32	9.08	54.45
YOL00091	91shotsegy	403	170	5.83	34.95
YOL00097	97shotsegy	410	32	9.45	56.7
YOL00103	103shotsegy	417	32	9.63	57.75
YOL00109	109shotsegy	425	32	9.83	58.95
YOL00115	115shotsegy	412	52	9	54
YOL00121	121shotsegy	439	32	10.18	61.05
YOL00127	127shotsegy	447	32	10.38	62.25
YOL00133	133shotsegy	454	32	10.55	63.3
YOL00139	139shotsegy	461	32	10.73	64.35
YOL00145	145shotsegy	469	32	10.93	65.55
YOL00151	151shotsegy	476	32	11.1	66.6
YOL00157	157shotsegy	484	32	11.3	67.8
YOL00163	163shotsegy	491	32	11.48	68.85
YOL00169	169shotsegy	498	32	11.65	69.9
YOL00175	175shotsegy	506	32	11.85	71.1
YOL00181	181shotsegy	513	32	12.03	72.15
YOL00187	187shotsegy	520	32	12.2	73.2
YOL00193	193shotsegy	110	606	12.4	74.4
YOL00199	199shotsegy	110	613	12.58	75.45
YOL00205	205shotsegy	110	621	12.78	76.65
YOL00211	211shotsegy	110	628	12.95	77.7
YOL00217	217shotsegy	110	635	13.13	78.75

YOL00223	223shotsegy	110	643	13.33	79.95
YOL00229	229shotsegy	110	650	13.5	81
YOL00235	235shotsegy	110	657	13.68	82.05
YOL00241	241shotsegy	126	584	11.45	68.7
YOL00247	247shotsegy	113	672	13.98	83.85
YOL00253	253shotsegy	110	675	14.13	84.75
YOL00259	259shotsegy	116	687	14.28	85.65
YOL00265	265shotsegy	117	694	14.43	86.55
YOL00271	271shotsegy	119	702	14.58	87.45
YOL00277	277shotsegy	120	709	14.73	88.35
YOL00283	283shotsegy	122	717	14.88	89.25
YOL00289	289shotsegy	123	724	15.03	90.15
YOL00295	295shotsegy	124	731	15.18	91.05
YOL00301	301shotsegy	126	739	15.33	91.95
YOL00307	307shotsegy	127	486	8.98	53.85
YOL00313	313shotsegy	143	753	15.25	91.5
YOL00319	319shotsegy	130	761	15.78	94.65
YOL00325	325shotsegy	131	768	15.93	95.55
YOL00331	331shotsegy	133	593	11.5	69
YOL00337	337shotsegy	134	783	16.23	97.35
YOL00343	343shotsegy	135	609	11.85	71.1
YOL00349	349shotsegy	137	798	16.53	99.15
YOL00355	355shotsegy	138	805	16.68	100.05
YOL00361	361shotsegy	140	813	16.83	100.95
YOL00367	367shotsegy	141	820	16.98	101.85
YOL00373	373shotsegy	142	827	17.13	102.75
YOL00379	379shotsegy	144	829	17.13	102.75
YOL00385	385shotsegy	145	829	17.1	102.6
YOL00391	391shotsegy	147	829	17.05	102.3
YOL00397	397shotsegy	148	829	17.03	102.15
YOL00403	403shotsegy	149	749	15	90
YOL00409	409shotsegy	151	829	16.95	101.7
YOL00415	415shotsegy	152	829	16.93	101.55
YOL00421	421shotsegy	154	829	16.88	101.25
YOL00427	427shotsegy	155	829	16.85	101.1
YOL00433	433shotsegy	157	829	16.8	100.8
YOL00439	439shotsegy	158	829	16.78	100.65
YOL00445	445shotsegy	160	356	4.9	29.4
YOL00451	451shotsegy	161	829	16.7	100.2
YOL00457	457shotsegy	162	829	16.68	100.05
YOL00463	463shotsegy	164	829	16.63	99.75
YOL00469	469shotsegy	165	829	16.6	99.6

YOL00475	475shotsegy	167	829	16.55	99.3
YOL00481	481shotsegy	168	829	16.53	99.15
YOL00487	487shotsegy	170	829	16.48	98.85
YOL00493	493shotsegy	171	829	16.45	98.7
YOL00499	499shotsegy	173	829	16.4	98.4
YOL00505	505shotsegy	174	829	16.38	98.25
YOL00511	511shotsegy	175	829	16.35	98.1
YOL00517	517shotsegy	177	829	16.3	97.8
YOL00523	523shotsegy	178	829	16.28	97.65
YOL00529	529shotsegy	180	815	15.88	95.25
YOL00535	535shotsegy	181	829	16.2	97.2
YOL00541	541shotsegy	183	829	16.15	96.9
YOL00547	547shotsegy	184	829	16.13	96.75
YOL00553	553shotsegy	186	829	16.08	96.45
YOL00559	559shotsegy	187	829	16.05	96.3
YOL00565	565shotsegy	188	829	16.03	96.15
YOL00571	571shotsegy	190	829	15.98	95.85
YOL00577	577shotsegy	191	829	15.95	95.7
YOL00583	583shotsegy	208	467	6.48	38.85
YOL00589	589shotsegy	194	829	15.88	95.25
YOL00595	595shotsegy	196	829	15.83	94.95
YOL00601	601shotsegy	197	829	15.8	94.8
YOL00607	607shotsegy	198	829	15.78	94.65
YOL00613	613shotsegy	200	829	15.73	94.35
YOL00619	619shotsegy	201	829	15.7	94.2
YOL00625	625shotsegy	203	829	15.65	93.9
YOL00631	631shotsegy	212	829	15.43	92.55
YOL00637	637shotsegy	748	128	15.5	93
YOL00643	643shotsegy	744	129	15.38	92.25
YOL00649	649shotsegy	740	131	15.23	91.35
YOL00655	655shotsegy	735	132	15.08	90.45
YOL00661	661shotsegy	732	133	14.98	89.85
YOL00667	667shotsegy	728	135	14.83	88.95
YOL00673	673shotsegy	724	136	14.7	88.2
YOL00679	679shotsegy	720	138	14.55	87.3
YOL00685	685shotsegy	716	139	14.43	86.55
YOL00691	691shotsegy	712	141	14.28	85.65
YOL00697	697shotsegy	709	147	14.05	84.3
YOL00703	703shotsegy	705	143	14.05	84.3
YOL00709	709shotsegy	701	145	13.9	83.4
YOL00715	715shotsegy	697	145	13.8	82.8
YOL00721	721shotsegy	693	148	13.63	81.75

YOL00727	727shotsegy	689	149	13.5	81
YOL00733	733shotsegy	685	150	13.38	80.25
YOL00739	739shotsegy	681	152	13.23	79.35
YOL00745	745shotsegy	677	153	13.1	78.6
YOL00751	751shotsegy	671	154	12.93	77.55
YOL00757	757shotsegy	669	156	12.83	76.95
YOL00763	763shotsegy	665	158	12.68	76.05
YOL00769	769shotsegy	661	159	12.55	75.3
YOL00775	775shotsegy	657	160	12.43	74.55
YOL00781	781shotsegy	653	162	12.28	73.65
YOL00787	787shotsegy	649	163	12.15	72.9
YOL00793	793shotsegy	645	165	12	72
YOL00799	799shotsegy	641	166	11.88	71.25
YOL00805	805shotsegy	637	168	11.73	70.35
YOL00811	811shotsegy	615	169	11.15	66.9
YOL00817	817shotsegy	629	170	11.48	68.85
YOL00823	823shotsegy	625	172	11.33	67.95
YOL00829	829shotsegy	621	173	11.2	67.2
YOL00835	835shotsegy	617	183	10.85	65.1
YOL00841	841shotsegy	613	172	11.03	66.15
YOL00847	847shotsegy	609	177	10.8	64.8
YOL00853	853shotsegy	605	179	10.65	63.9
YOL00859	859shotsegy	601	188	10.33	61.95
YOL01055	1055shotsegy	358	40	7.95	47.7
YOL01067	1067shotsegy	340	40	7.5	45
YOL01085	1085shotsegy	184	40	3.6	21.6
YOL01115	1115shotsegy	420	80	8.5	51
YOL01133	1133shotsegy	410	40	9.25	55.5
YOL01145	1145shotsegy	345	38	7.68	46.05
YOL01187	1187shotsegy	510	40	11.75	70.5
YOL01343	1343shotsegy	140	780	16	96
YOL01349	1349shotsegy	140	370	5.75	34.5
YOL01367	1367shotsegy	150	810	16.5	99
YOL01421	1421shotsegy	300	825	13.13	78.75
YOL01439	1439shotsegy	170	545	9.38	56.25
YOL01451	1451shotsegy	170	820	16.25	97.5
YOL01469	1469shotsegy	175	820	16.13	96.75
YOL01487	1487shotsegy	170	820	16.25	97.5
YOL01499	1499shotsegy	173	820	16.18	97.05
YOL01517	1517shotsegy	177	820	16.08	96.45
YOL01595	1595shotsegy	335	820	12.13	72.75
YOL01637	1637shotsegy	206	820	15.35	92.1

YOL01649	1649shotsegy	735	365	9.25	55.5
YOL01661	1661shotsegy	605	140	11.63	69.75
YOL01667	1667shotsegy	720	175	13.63	81.75
YOL01679	1679shotsegy	450	140	7.75	46.5
YOL01685	1685shotsegy	680	145	13.38	80.25
YOL01709	1709shotsegy	701	155	13.65	81.9
YOL01739	1739shotsegy	681	160	13.03	78.15
YOL01751	1751shotsegy	541	160	9.53	57.15
YOL01817	1817shotsegy	385	695	7.75	46.5
YOL01835	1835shotsegy	260	620	9	54
YOL10091	10091shotsegy	184	32	3.8	22.8
YOL10109	10109shotsegy	406	374	0.8	4.8
YOL10307	10307shotsegy	486	745	6.48	38.85
YOL10319	10319shotsegy	301	380	1.98	11.85
YOL10331	10331shotsegy	500	776	6.9	41.4
YOL10343	10343shotsegy	594	790	4.9	29.4
TOTAL		178lines	90966 shots	2269.68	13618.05

12.2 Deliverables

Datasets	Type of media	Type of Data	Tape/File name	Range	Date delivered
Final Processing Report	FTP	PDF	yollaRepro_002_FinalProcessingReport_100407.pdf		07/04/2010
Final Velocities	CD/DVD	SEGY	yollaRepro_002_3rdTomographicUpdate_Interval_Velocity_TWT_20100118.segy	IL:33-906[1] CL:116-1680[1] Time:0-6000[4]	19/01/2010
Pre- Processed Gathers (with Gun/streamer correction and Phase balancing/zero phase)	USB	SEGY	yollaRepro_002_Regularised_Gathers_IL36-100_TWT_20100206.segy yollaRepro_002_Regularised_Gathers_IL101-200_TWT_20100206.segy yollaRepro_002_Regularised_Gathers_IL201-300_TWT_20100206.segy yollaRepro_002_Regularised_Gathers_IL301-400_TWT_20100206.segy yollaRepro_002_Regularised_Gathers_IL401-500_TWT_20100206.segy yollaRepro_002_Regularised_Gathers_IL501-600_TWT_20100206.segy yollaRepro_002_Regularised_Gathers_IL601-700_TWT_20100206.segy yollaRepro_002_Regularised_Gathers_IL701-800_TWT_20100206.segy yollaRepro_002_Regularised_Gathers_IL801-900_TWT_20100206.segy yollaRepro_002_Regularised_Gathers_IL901-904_TWT_20100206.segy	IL:36-904[1] CL:119-1677[1] Offset: 160-3160[100] Time:0-6000[2]	16/02/2010 to Randall Taylor 08/03/2010 to Darren Rutley
NMO Corrected PSDM Gathers converted to Time (with Gun/streamer correction and Phase balancing/zero phase)	USB	SEGY	yollaRepro_002_Radon_Gathers_IL33-100_TWT_20100206.segy yollaRepro_002_Radon_Gathers_IL101-200_TWT_20100206.segy yollaRepro_002_Radon_Gathers_IL201-300_TWT_20100206.segy yollaRepro_002_Radon_Gathers_IL301-400_TWT_20100206.segy yollaRepro_002_Radon_Gathers_IL401-500_TWT_20100206.segy yollaRepro_002_Radon_Gathers_IL501-600_TWT_20100206.segy yollaRepro_002_Radon_Gathers_IL601-700_TWT_20100206.segy yollaRepro_002_Radon_Gathers_IL701-800_TWT_20100206.segy yollaRepro_002_Radon_Gathers_IL801-900_TWT_20100206.segy yollaRepro_002_Radon_Gathers_IL901-906_TWT_20100206.segy	IL:33-906[1] CL:116-1680[1] Offset: 1060-3060[100] Time:0-6000[2]	16/02/2010 to Randall Taylor 08/03/2010 to Darren Rutley
Raw and filtered/scaled migrated stack	3592 Tape	SEGY	yollaRepro_002_FullStack_GDA94_TWT_20100127.segy yollaRepro_002_FullStack_GDA94_TVDSS_20100127.segy EnhancedFullStack_GDA94_TWT_20100127.segy	IL:33-906[1] CL:116-1680[1] Time:0-6000[2] Depth:0-13998[3]	29/01/2010
AVO intercept and gradient stack	3592 Tape	SEGY	yollaRepro_002_Gradient_GDA94_TWT_20100312.segy yollaRepro_002_Intercept_GDA94_TWT_20100312.segy	IL:33-906[1] CL:116-1680[1] Time:0-6000[2]	15/03/2010

Datasets	Type of media	Type of Data	Tape/File name	Range	Date delivered
Near, mid and far migrated angle stack	DVD/LTO Tape	SEGY	yollaRepro_002_AngleStack_5-15DEG_GDA94_TWT_20100202.segy yollaRepro_002_AngleStack_15-25DEG_GDA94_TWT_20100202.segy yollaRepro_002_AngleStack_25-35DEG_GDA94_TWT_20100202.segy	IL:33-906[1] CL:116-1680[1] Time:0-6000[2]	16/02/2010 to Randall Taylor 08/03/2010 to Darren Rutley

12.3 EBCDIC header (example)

```
C01 CLIENT: ORIGIN     AREA: YOLLA 3D SURVEY; BASS BASIN BLOCK T/RL 1
C02 DATASET: ENHANCED FULL STACK IN TIME
C03 PROCESSED BY DOWNUNDER GEOSOLUTIONS  JUL 2009-NOV 2009
C04
C05 POLARITY: INCREASE IN IMPEDANCE IS NEGATIVE NUMBERS (TROUGH)
C06 INLINE RANGE:  33 - 906 (1)  CROSSLINE RANGE: 116 - 1680 (1)
C07 -------------PROCESSING FLOW --------------
C08 REFORMAT FROM SEGD TO INTERNAL FORMAT
C09 TIDAL STATICS;  SOURCE SIGNATURE ZERO PHASING
C10 LOW CUT FILTER TO REMOVE BIAS (2-4 HZ)
C11 SWELL NOISE ATTENUATION
C12 SHOTPOINT INTERPOLATION TO DEALIAS MULTIPLE ENERGY (FINAL SPI 12.5M)
C13 DIP FILTERING ON NMO CDPS (ATTENUATED DIPS 8.22 - 17.0 MS/TRC)
C14 SURFACE MULTIPLE ELIMINATION
C15 TAU-P DECONVOLUTION (GAP 32MS OPER: 600MS) AND MUTE IN TAUP DOMAIN
C16 RADON DEMULTIPLE (MODEL -300 TO 2500 AT 3500M CUT: 120MS)
C17 PRESTACK KIRCHHOFF ANISOTROPIC DEPTH MIGRATION MODEL BUILDING
C18 2 PASSES OF TOMOGRAPHIC UPDATING
C19 PRESTACK KIRCHHOFF ANISOTROPIC DEPTH MIGRATION
C20 CONVERT FROM DEPTH TO TIME
C21 RADON DEMULTIPLE (MODEL -100 To 500 AT 3200M CUT: 50MS STARTTIME 1500MS)
C22 INNER AND OUTER TRACE MUTING
C23 BLACKMAN WEIGHTED STACK
C24 FREQUENCY ENHANCEMENT
C25 OUTPUT TO SEGY
C26 -------------GRID DEFINITION---------------
C27 PROJECTION:UTM 055  SOUTH    SPHEROID:WGS-84      DATUM:GDA-94
C28 CENTRAL MERIDIAN:147 00 00.OO E LAT ORIGIN:00 00 00.00 N
C29 FALSE EAST:500000   FALSE NORTH:10000000.00    SCALE FACTOR:+0.999600
C30   IL    CL         X            Y
C31    34   117   402168.810   5573478.481
C32    34  1676   412868.767   5589765.718
C33   905  1676   394669.620   5601721.710
C34   905   117   383969.663   5585434.473
C35
C36  DESC                  BYTE LOCATION        FORMAT
C37  3D INLINE NUMBER          9- 12      32 BIT INTEGER
C38  3D CROSSLINE  NUMBER     21- 24      32 BIT INTEGER
C39  CDP_X                    73- 76      32 BIT INTEGER
C40  CDP_Y                    77- 80      32 BIT INTEGER
```

12.4 Zerophasing coefficients

1	0.13467319E-02	0.27787373E-05	0.34934221E-03	0.20821206E-03	0.17615758E-02
6	0.45246456E-03	0.64377784E-03	0.13655550E-02	0.20025775E-02	0.11949555E-02
11	0.58712170E-03	0.19265505E-02	0.25496834E-02	0.19603306E-02	0.10952685E-02
16	0.22881364E-02	0.31644993E-02	0.20816126E-02	0.12538288E-02	0.26850353E-02
21	0.39459104E-02	0.23766579E-02	0.11695450E-02	0.27297495E-02	0.40346030E-02
26	0.22821666E-02	0.96828042E-03	0.28537973E-02	0.40762080E-02	0.17563881E-02
31	0.34502977E-04	0.21877089E-02	0.36822772E-02	0.10470195E-02	-0.10073434E-02
36	0.12007328E-02	0.25583354E-02	-0.75228070E-03	-0.30738891E-02	-0.33901559E-03
41	0.12397408E-02	-0.28151339E-02	-0.58246846E-02	-0.30005600E-02	-0.14004867E-02
46	-0.59856139E-02	-0.91465134E-02	-0.57941033E-02	-0.43371124E-02	-0.10169987E-01
51	-0.14075520E-01	-0.10130008E-01	-0.82146311E-02	-0.14667722E-01	-0.19032924E-01
56	-0.14855485E-01	-0.13340774E-01	-0.21070225E-01	-0.25579093E-01	-0.20023778E-01
61	-0.17966645E-01	-0.27022239E-01	-0.32690901E-01	-0.26748700E-01	-0.24465637E-01
66	-0.34113504E-01	-0.39508861E-01	-0.31997796E-01	-0.29916996E-01	-0.42088069E-01
71	-0.48512843E-01	-0.38917217E-01	-0.35117175E-01	-0.48037745E-01	-0.54674909E-01
76	-0.44209171E-01	-0.41298412E-01	-0.56390420E-01	-0.61856441E-01	-0.47008552E-01
81	-0.42525601E-01	-0.60125694E-01	-0.67925252E-01	-0.51869776E-01	-0.45905441E-01
86	-0.63196033E-01	-0.68466112E-01	-0.48352055E-01	-0.42371869E-01	-0.67028187E-01
91	-0.73475629E-01	-0.46332333E-01	-0.33962693E-01	-0.59724223E-01	-0.66988580E-01
96	-0.35817876E-01	-0.31529926E-01	-0.58766797E-01	-0.62178388E-01	-0.12425203E-01
101	-0.97114220E-02	-0.41521996E-01	-0.53224668E-01	-0.72103245E-02	0.74731680E-02
106	-0.23490267E-01	-0.21763174E-01	0.32350257E-01	0.43884326E-01	-0.21943780E-01
111	-0.35934489E-01	0.60143996E-01	0.10966918E+00	0.26911315E-01	0.47506806E-02
116	0.96601471E-01	0.95929608E-01	-0.24226099E-01	0.19669547E-02	0.28862697E+00
121	0.22730620E+00	-0.86835191E-01	-0.71026459E-01	-0.15906045E+00	0.59207279E-01
126	-0.11762858E+00	-0.49703941E+00	0.29673912E-02	0.12259566E+00	-0.76178402E-01
131	0.54194915E+00	-0.15320584E+00	-0.32217804E-01	-0.14183502E+00	0.23255712E+00
136	-0.39822903E-01	0.81251428E-01	0.16142479E+00	0.73057036E-02	-0.27742956E-01
141	-0.11445396E-01	0.10796914E+00	0.50316218E-01	0.88117547E-01	0.59688509E-01
146	0.12304736E-01	0.11330143E-01	0.29128009E-01	0.52625079E-01	0.52825447E-01
151	0.68379581E-01	0.24351750E-01	-0.61370144E-02	0.10516479E-01	0.29051550E-01
156	0.31548284E-01	0.34568574E-01	0.36947086E-01	0.12222564E-01	-0.75627666E-03
161	0.95642386E-02	0.31722534E-01	0.32141928E-01	0.28790534E-01	0.99550951E-02
166	0.52844565E-02	-0.89196226E-03	0.57115895E-02	0.99928416E-02	0.19449316E-01
171	0.17148843E-01	0.18558225E-02	-0.57235290E-02	-0.24192696E-02	0.78952974E-02
176	0.77775223E-02	0.55373963E-02	-0.21485635E-02	-0.11434516E-01	-0.19162994E-01
181	-0.20228317E-01	-0.15390632E-01	-0.13289882E-01	-0.15533935E-01	-0.23534693E-01
186	-0.30046798E-01	-0.32363668E-01	-0.27831363E-01	-0.16521621E-01	-0.45774789E-02
191	0.58992115E-04	-0.22283921E-02	-0.52528731E-02	-0.71201287E-02	-0.11295645E-01
196	-0.20987123E-01	-0.30926298E-01	-0.36748350E-01	-0.40132657E-01	-0.39828863E-01
201	-0.37340857E-01	-0.36526576E-01	-0.38693860E-01	-0.42132705E-01	-0.44557240E-01
206	-0.44513982E-01	-0.42554881E-01	-0.41351069E-01	-0.40787172E-01	-0.40498529E-01
211	-0.41297812E-01	-0.42684600E-01	-0.42802233E-01	-0.40445231E-01	-0.38207661E-01
216	-0.37187755E-01	-0.36631439E-01	-0.35552464E-01	-0.34734212E-01	-0.34313779E-01
221	-0.33007454E-01	-0.30657111E-01	-0.29322321E-01	-0.29487694E-01	-0.29287091E-01
226	-0.28002899E-01	-0.27346391E-01	-0.28098999E-01	-0.28361209E-01	-0.27457695E-01
231	-0.27124304E-01	-0.27883282E-01	-0.26905404E-01	-0.24666345E-01	-0.23555934E-01
236	-0.23560492E-01	-0.22989852E-01	-0.21229248E-01	-0.21535255E-01	-0.23688424E-01
241	-0.25234610E-01	-0.25034996E-01	-0.25123106E-01	-0.25182990E-01	-0.24666103E-01
246	-0.22633525E-01	-0.21370914E-01	-0.22925895E-01	-0.22342237E-01	-0.18830275E-01
251	-0.15579120E-01	-0.16361877E-01	-0.15078405E-01	-0.11630908E-01	-0.11645765E-01
256	-0.10931822E-01	-0.65866932E-02	0.00000000E+00	0.00000000E+00	0.00000000E+00

12.5 References

1. Abma, R., Sun, J., and Bernitsas, N., 1999, Antialiasing methods in Kirchhoff migration: Geophysics, **64**, no. 6, 1783–1792.
2. Gray, S. H., 1992, Frequency-selective design of the Kirchhoff migration operator: Geophysical Prospecting, **40**, 565-571.
3. Dellinger, J. A., Gray, S. H., Murphy, G. E., and Etgen, J. T., 2000, Efficient 2.5-D true-amplitude migration: Geophysics, **65**, 943-950.

DownUnder GeoSolutions

Processing Report

17th July 2009

Origin Energy Resources Ltd

Yolla 3D Marine Seismic Survey Reprocessing

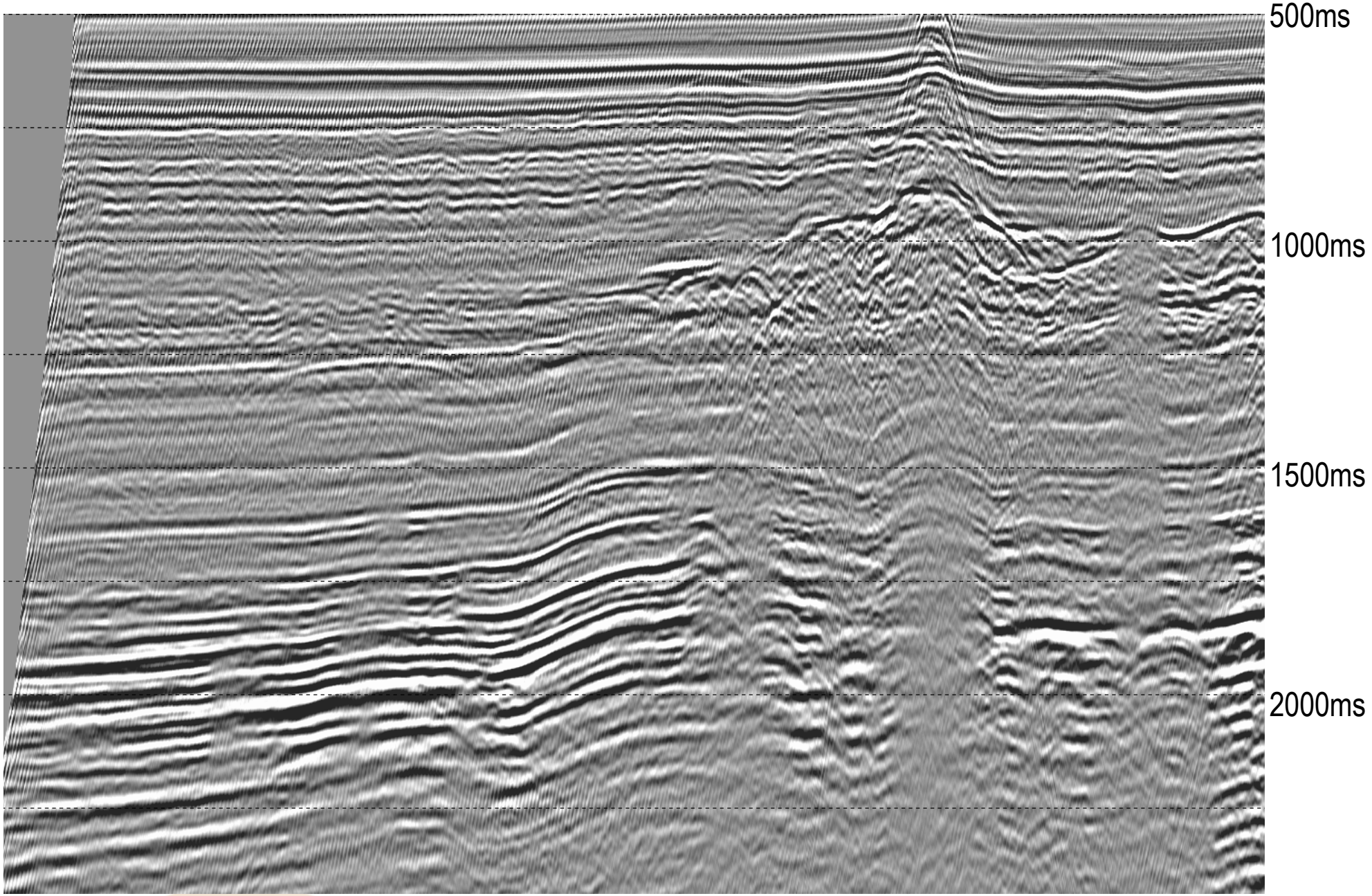
Introduction

- This report details the testing of the pre-migration workflow for the Yolla3D survey.
- Tests were run for sail lines corresponding to IL 531 & 465. All tests for both these lines were presented during the meeting. Only results for IL 531 is shown in this presentation including:
  - Signature zero phasing
  - Tidal static correction
  - Swell noise attenuation (SWATT)
  - Dip filtering
  - Surface Related Multiple Attenuation (SRME)
  - Tau-P deconvolution
  - SRME followed by Tau-P Deconvolution
  - SRME followed by Tau-P Deconvolution followed by Radon Demultiple

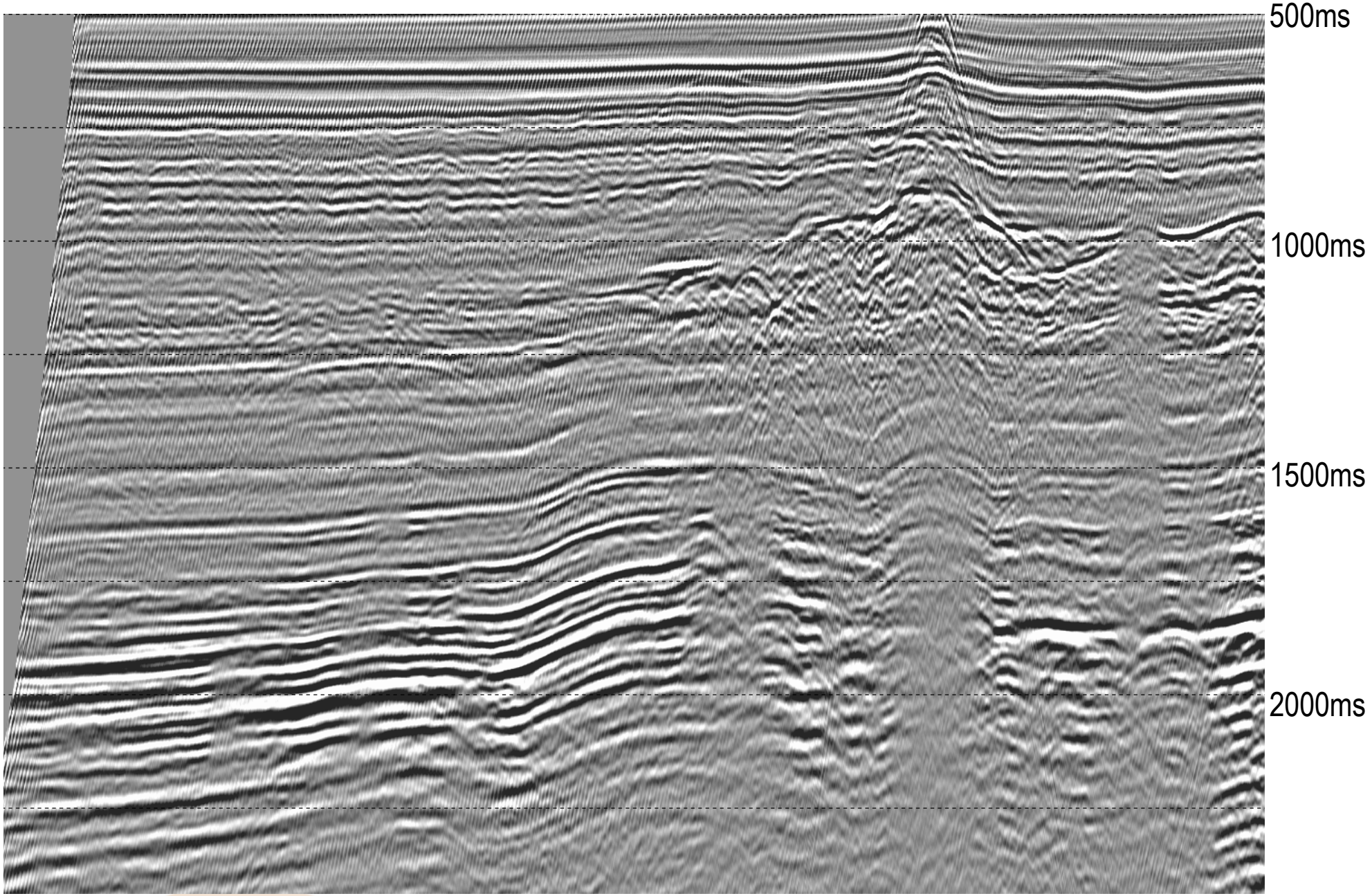
Source signature zero phasing

- A source signature was modelled using the supplied source array parameters. (see earlier report)
- A filter was then derived to convert this signature to it's zero phase equivalent.
- A filter was also derived to convert the source signature to the zero phase equivalent without the bubble energy. Tests with the two different filters were presented and all subsequent processing was applied to the data with the debubbling included in the zero phasing.

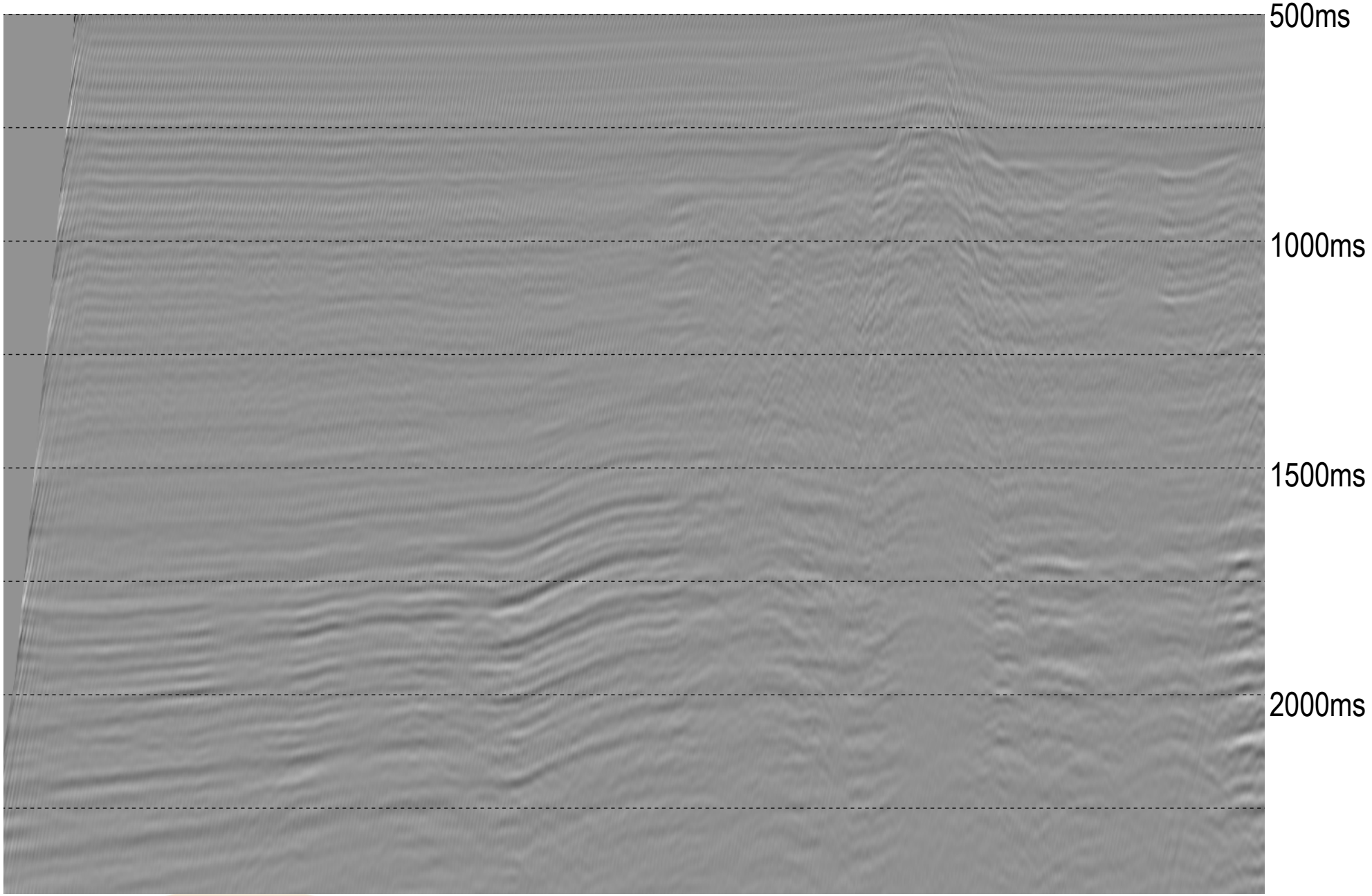
Zero Phasing Filters – No debubble - Stack



Zero Phasing Filters – With debubble - Stack



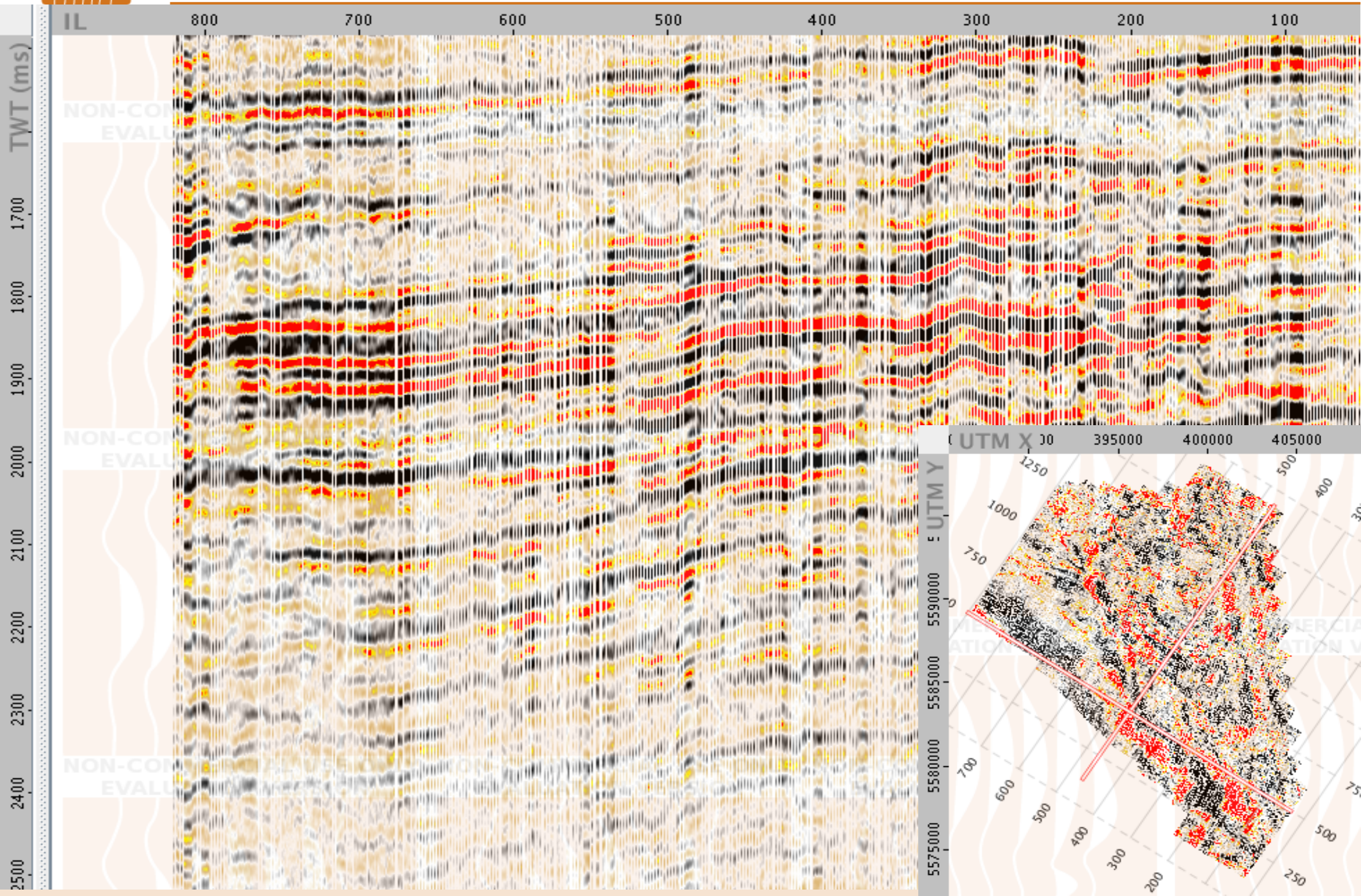
Difference – Stack (effect of the debubble)



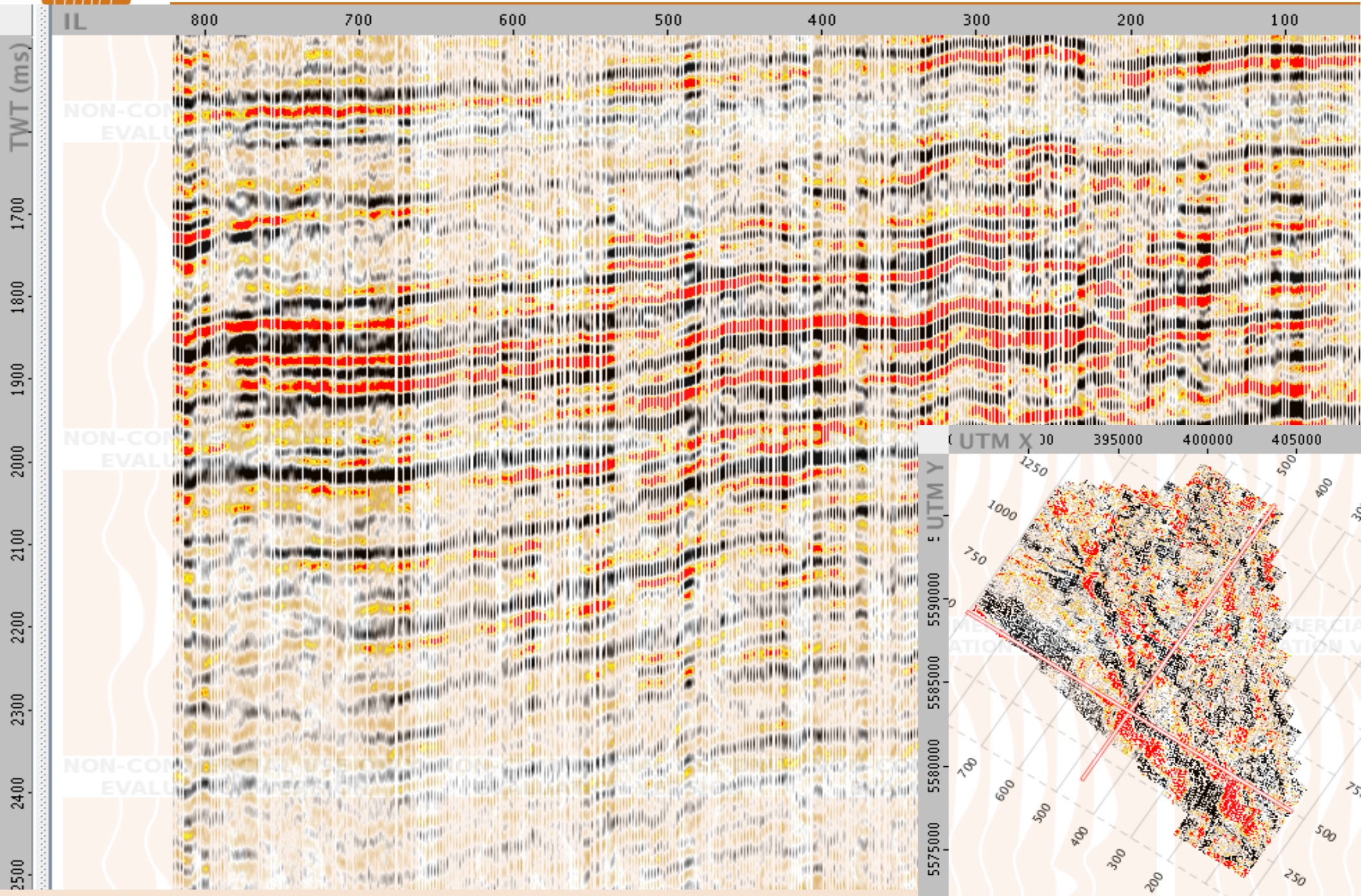
Tidal static correction

- Tidal tables were supplied in hard copy format. DUG scanned these and created electronic files that could be used for tidal calculations.
- The tides were quite large and application of the statics improved the continuity of the data dramatically. Plots of the water bottom cube before and after tidal corrections were generated and presented.
- Crossline 500 is shown before and after tidal statics. The traces have been NMOD with the supplied velocity field.

Water Bottom (CL:500)



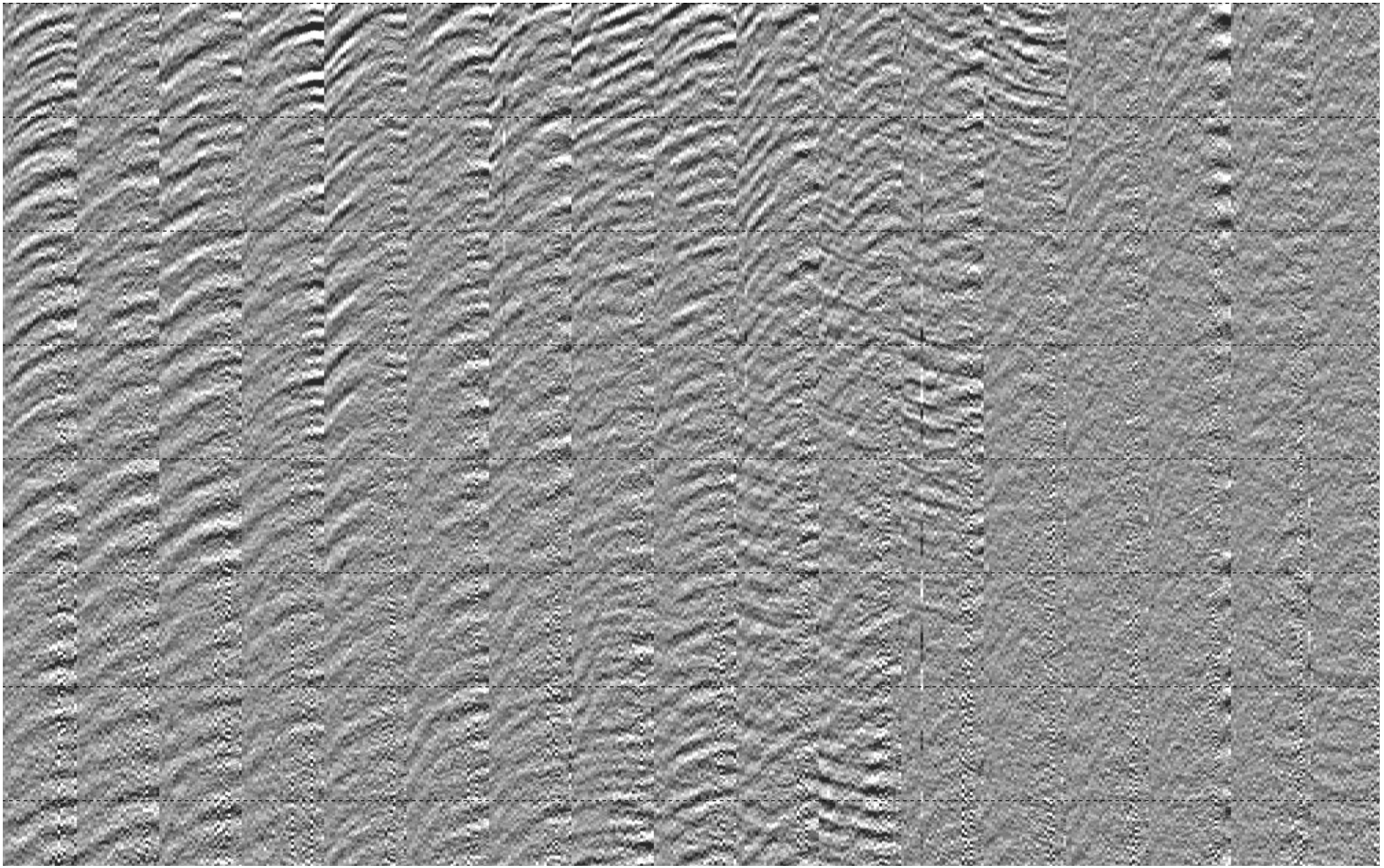
Water Bottom + Tidal Static (CL:500)



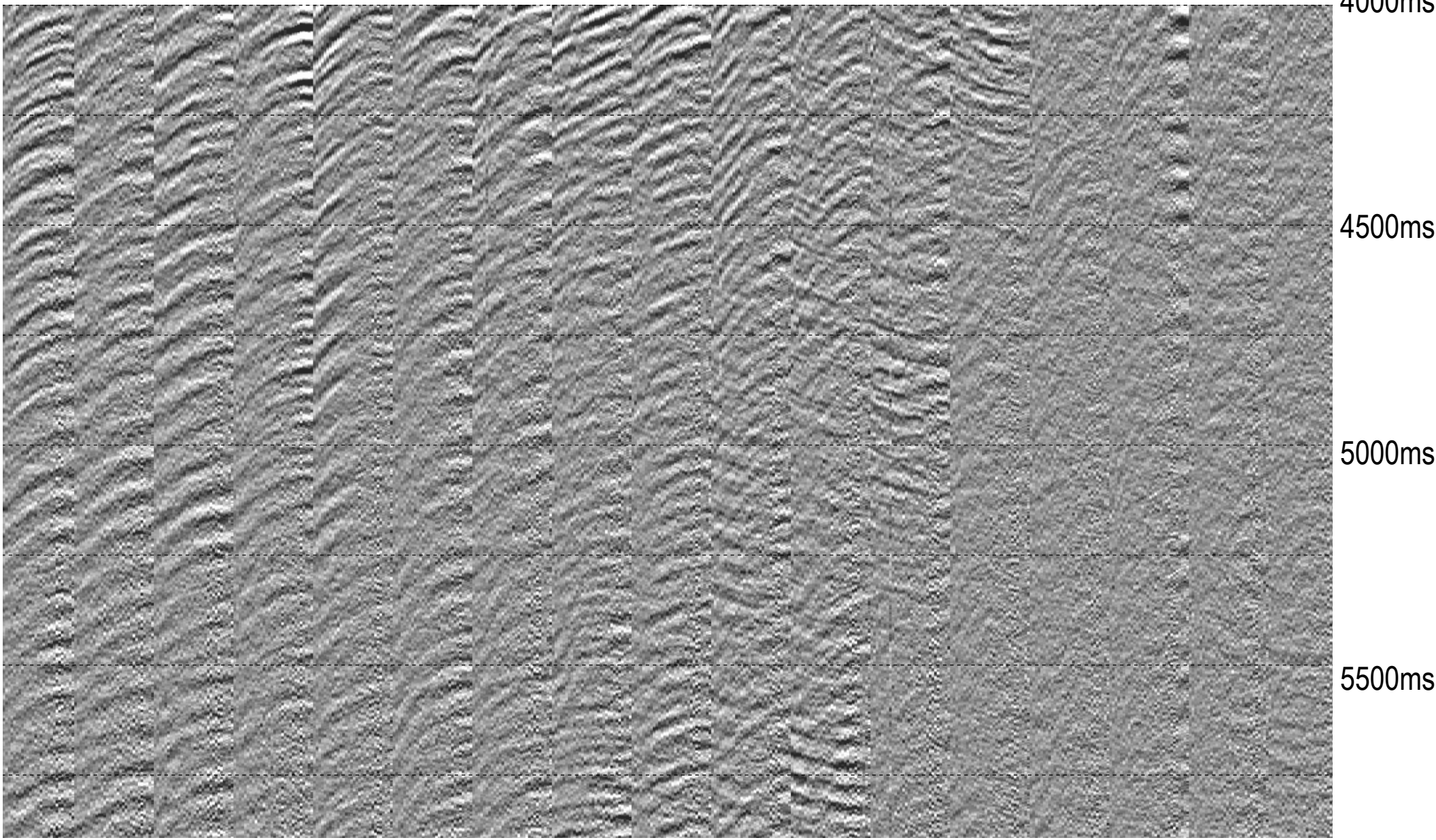
Swell Noise Attenuation (SWATT)

- The data contained very little swell noise. Swell noise attenuation was achieved by identifying and removing the swell noise in time-frequency bands within moving spatial and temporal windows. The windows employed were 7traces x 64ms. Noise was only removed when it was 5 times larger than the median value in the window. The process was run on NMOd CMPs to preserve primary energy.

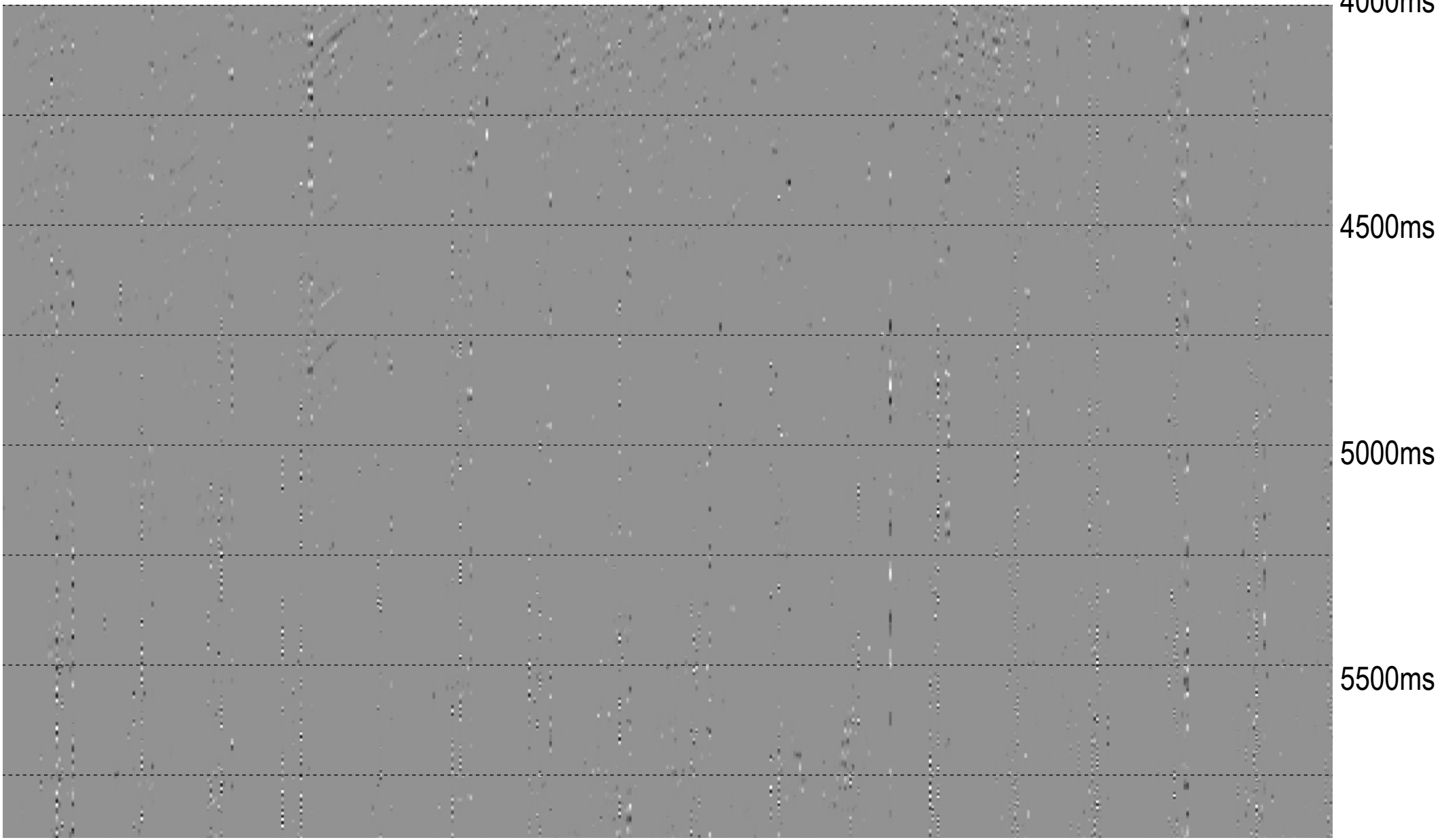
Selected CDPS – Before SWATT



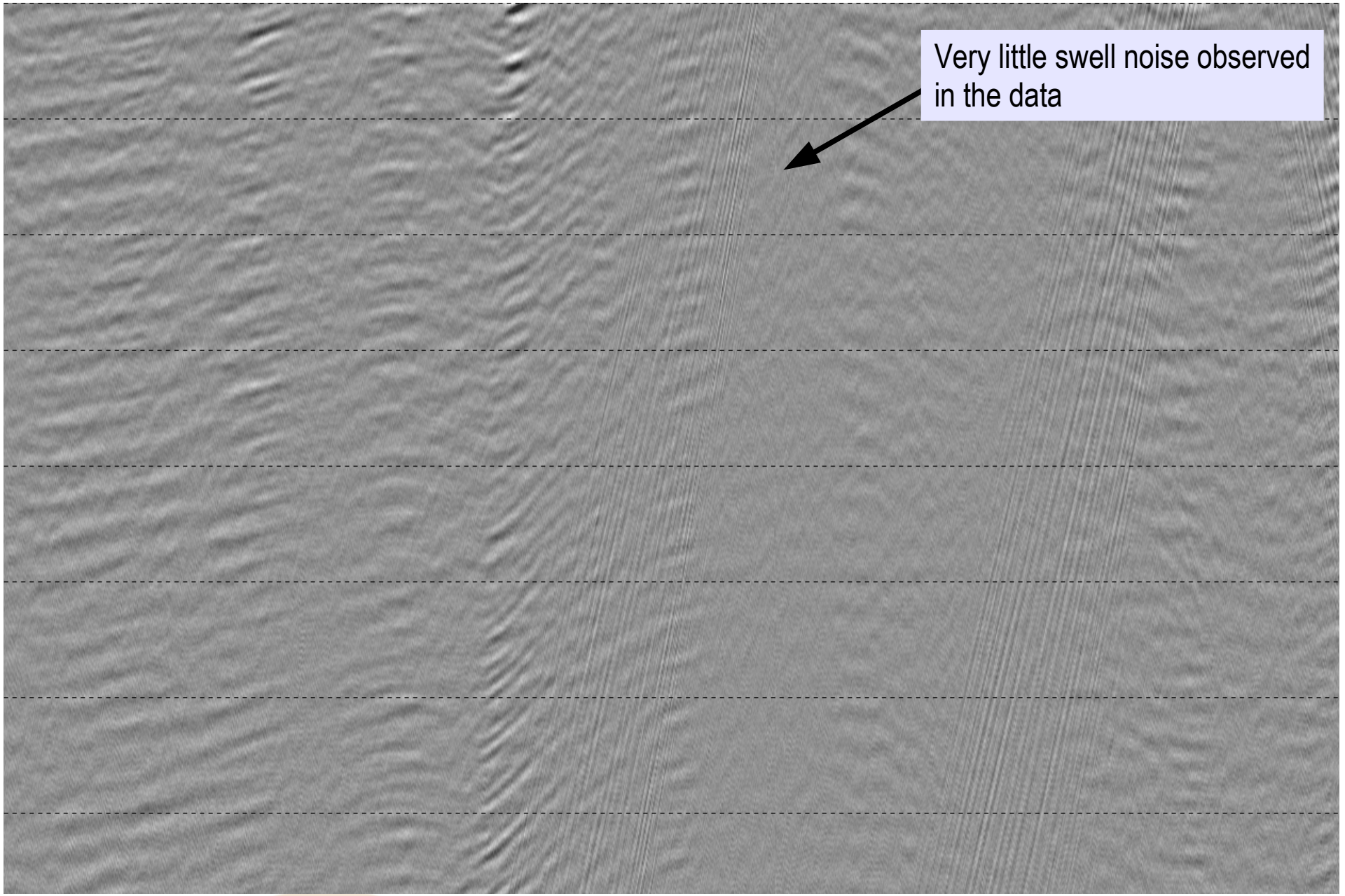
Selected CDPS – After SWATT



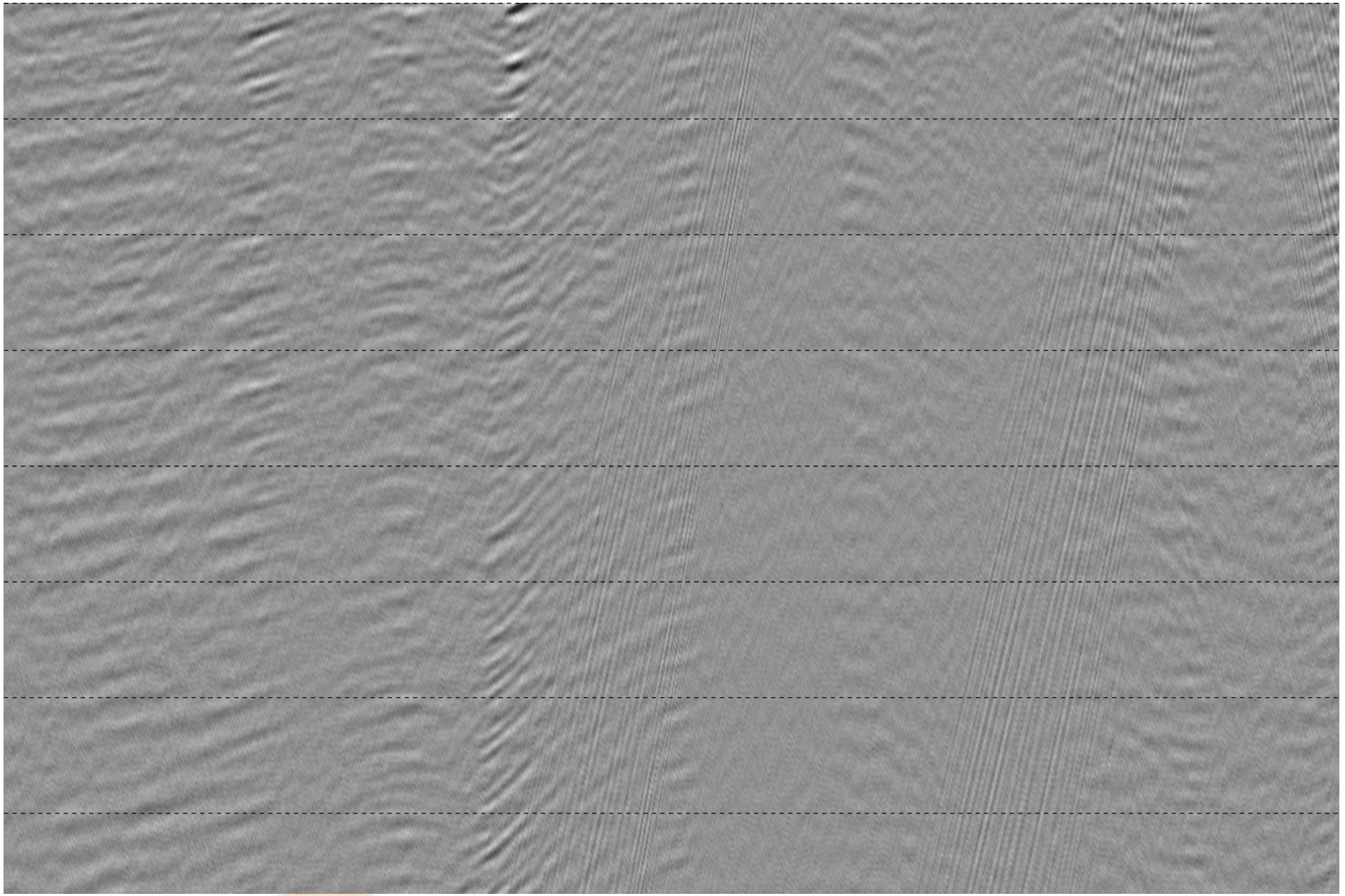
Noise removed by SWATT



Stack – Before SWATT



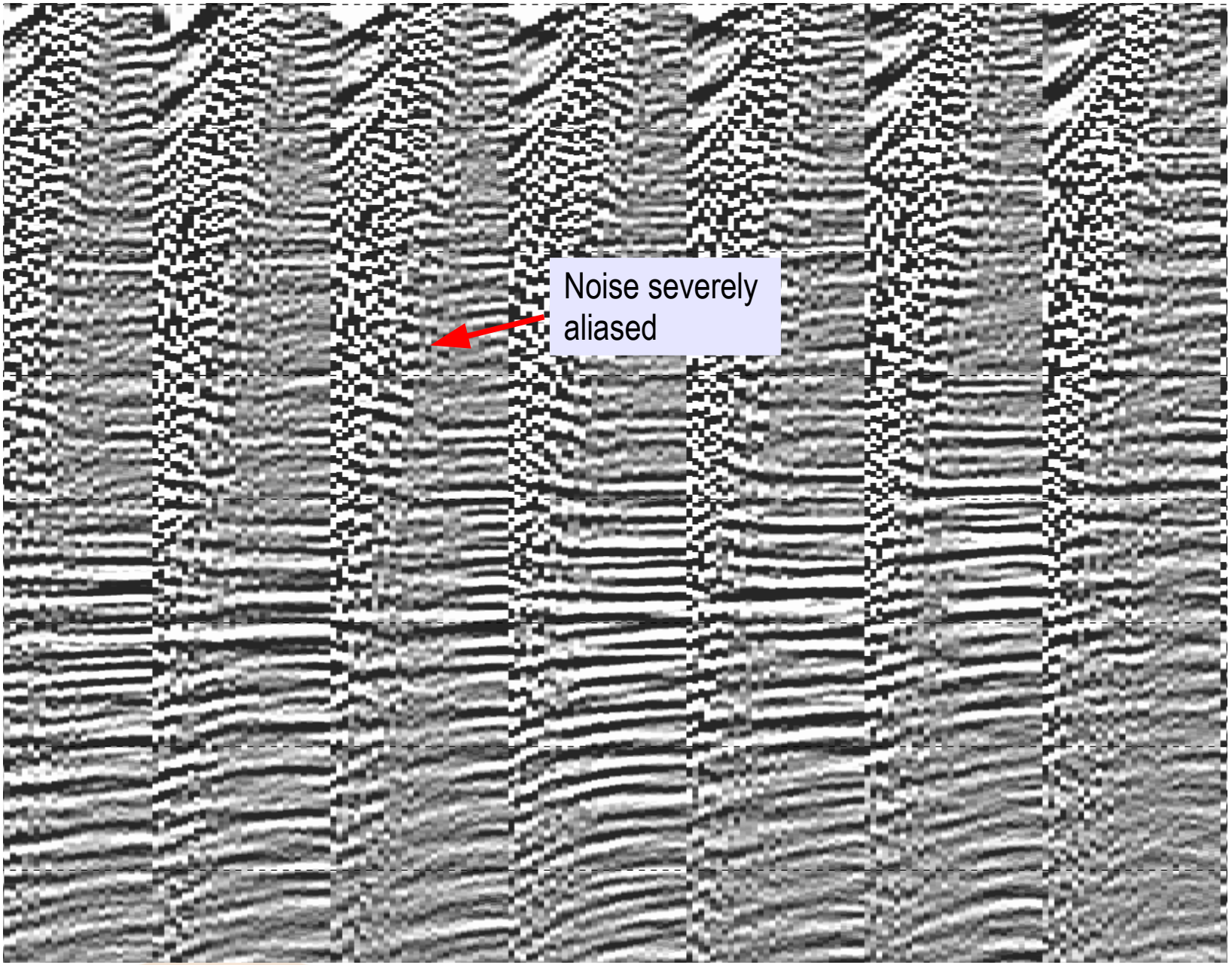
Stack – After SWATT



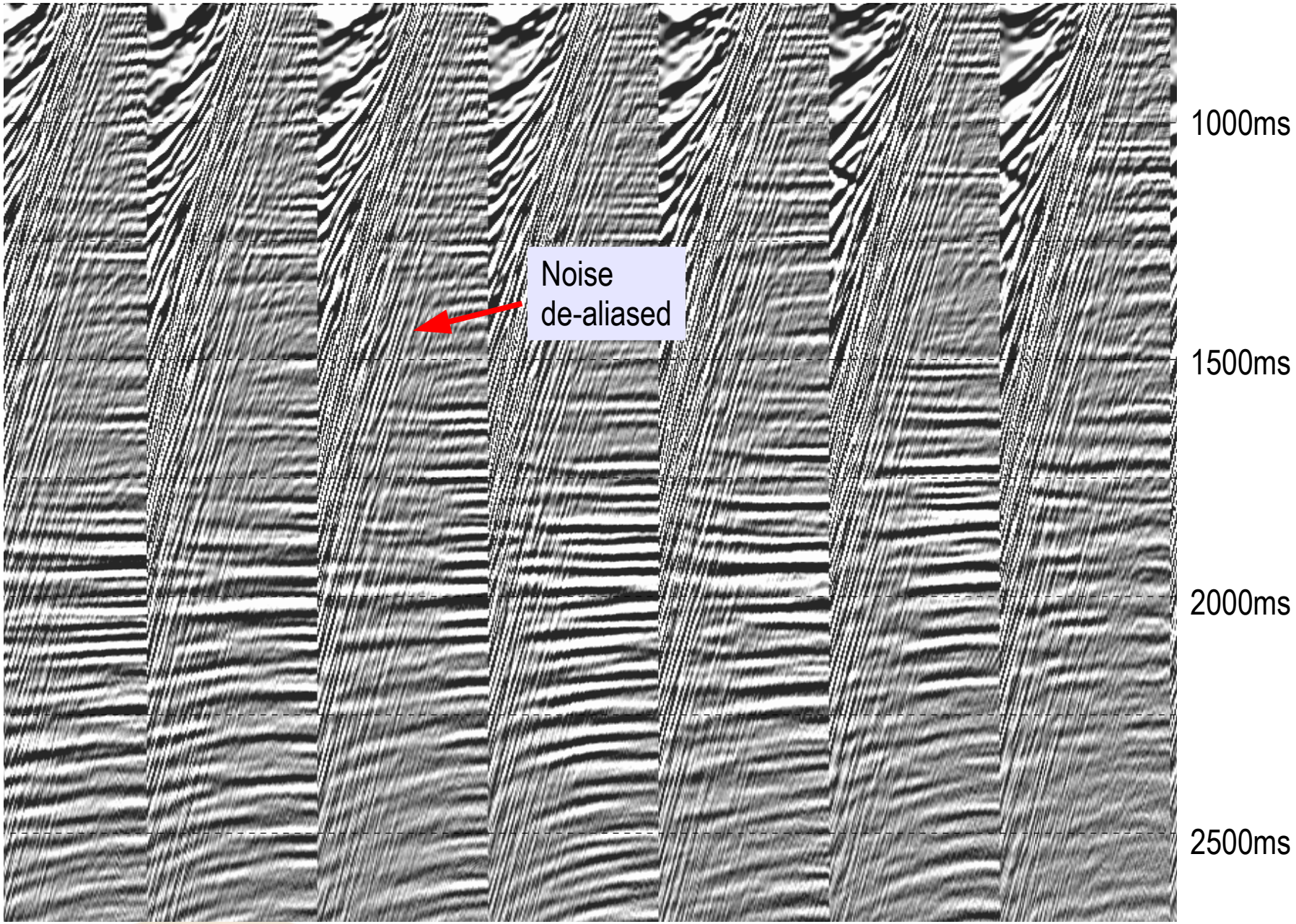
Dip Filtering

- Several tests were run to remove the strong dipping noise observed on the shot records. These tests include different velocity cuts applied to unmod and nmod shot records. It was found that these filters also remove some of the useful diffraction energy in the data. A methodology was therefore derived to try and preserve these diffraction. This was achieved by dealiasing the noise in the CDP domain through shotpoint interpolation.
- By performing the filtering in the CDP domain the primary energy can be better protected because primary energy is more concentrated after normal moveout.
  - Parameters for the dip filter were as follows:
    - Interpolation to a shot point increment of 12.5m
    - Sort to CDP and apply NMO
    - Remove dipping events with dip 8.22 – 17.0 ms/trace
- One must also be careful not to remove energy that may be needed by subsequent processes e.g. multiples. This always results in a trade-off.

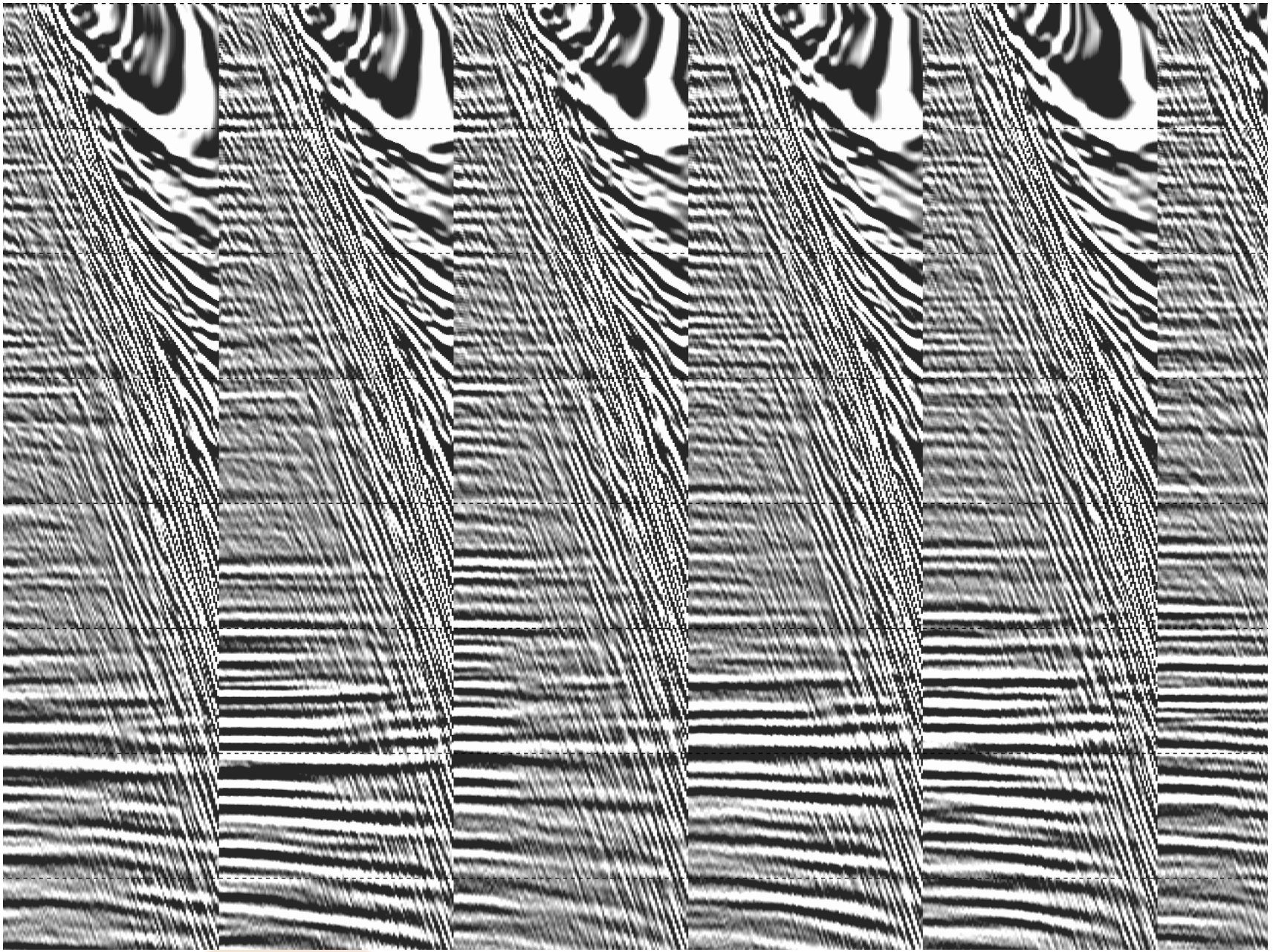
Interpolation – CDPs before Interpolation



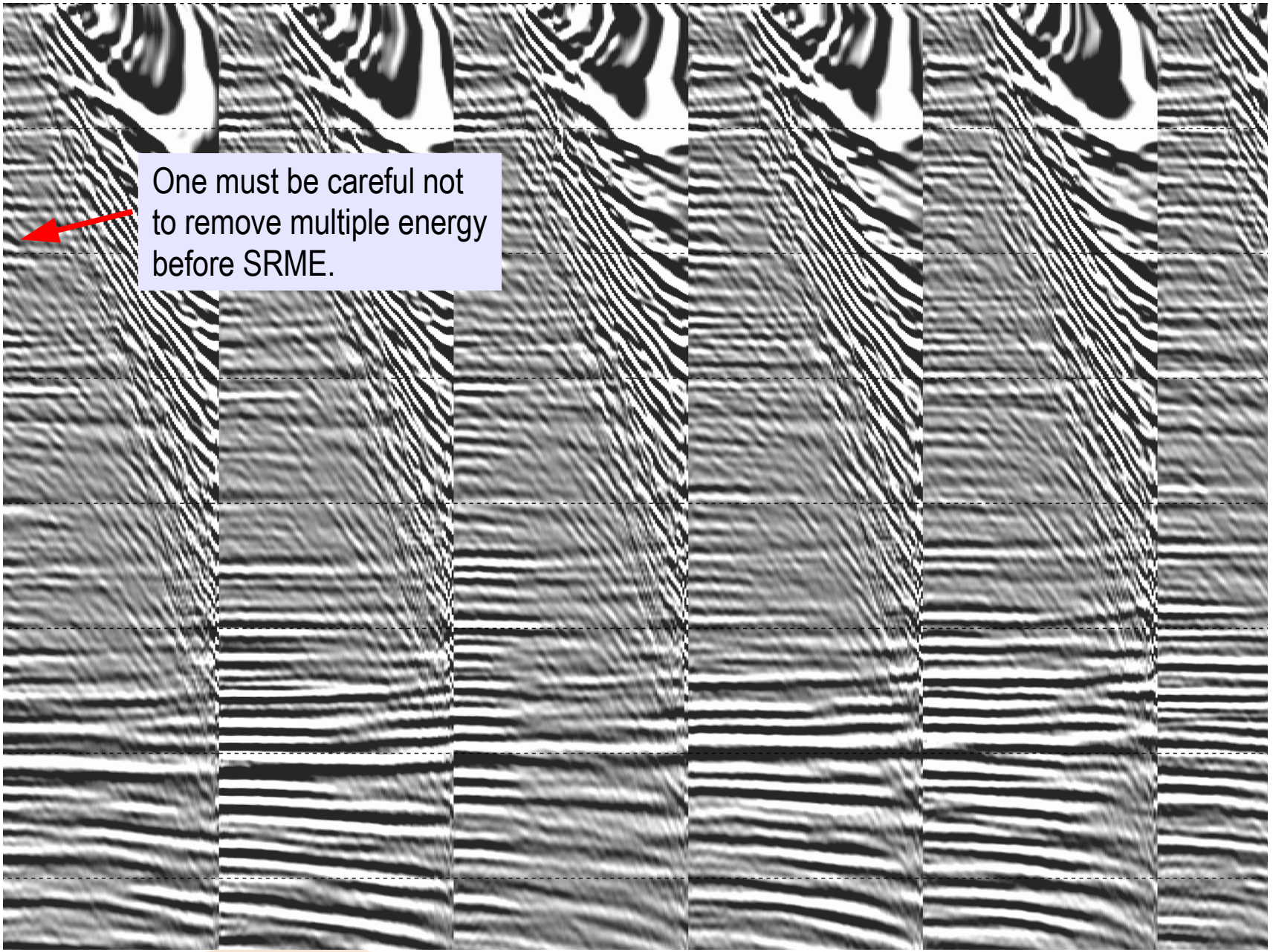
Interpolation – CDPs after Interpolation



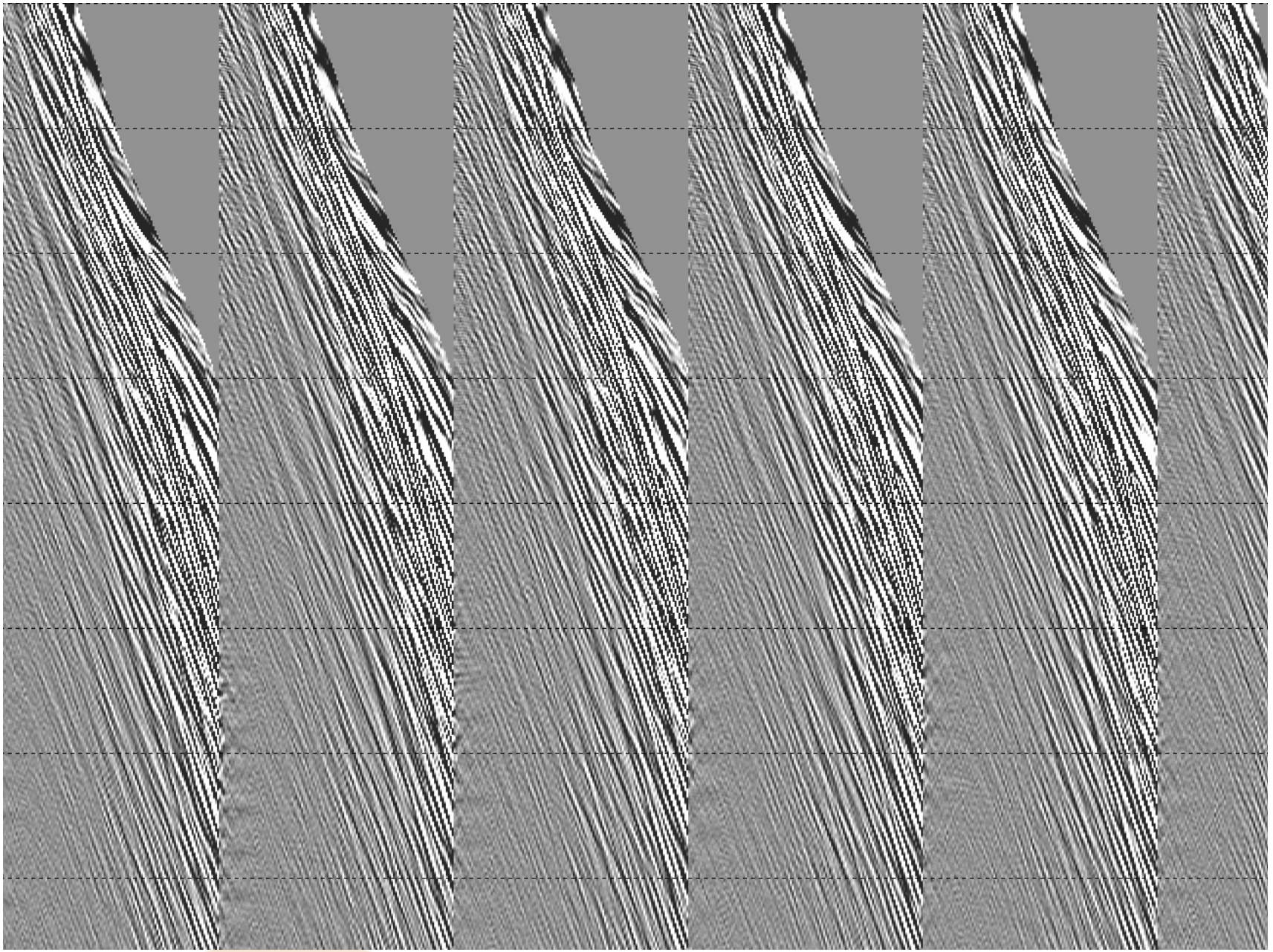
Interpolated CDPs - before dip filter



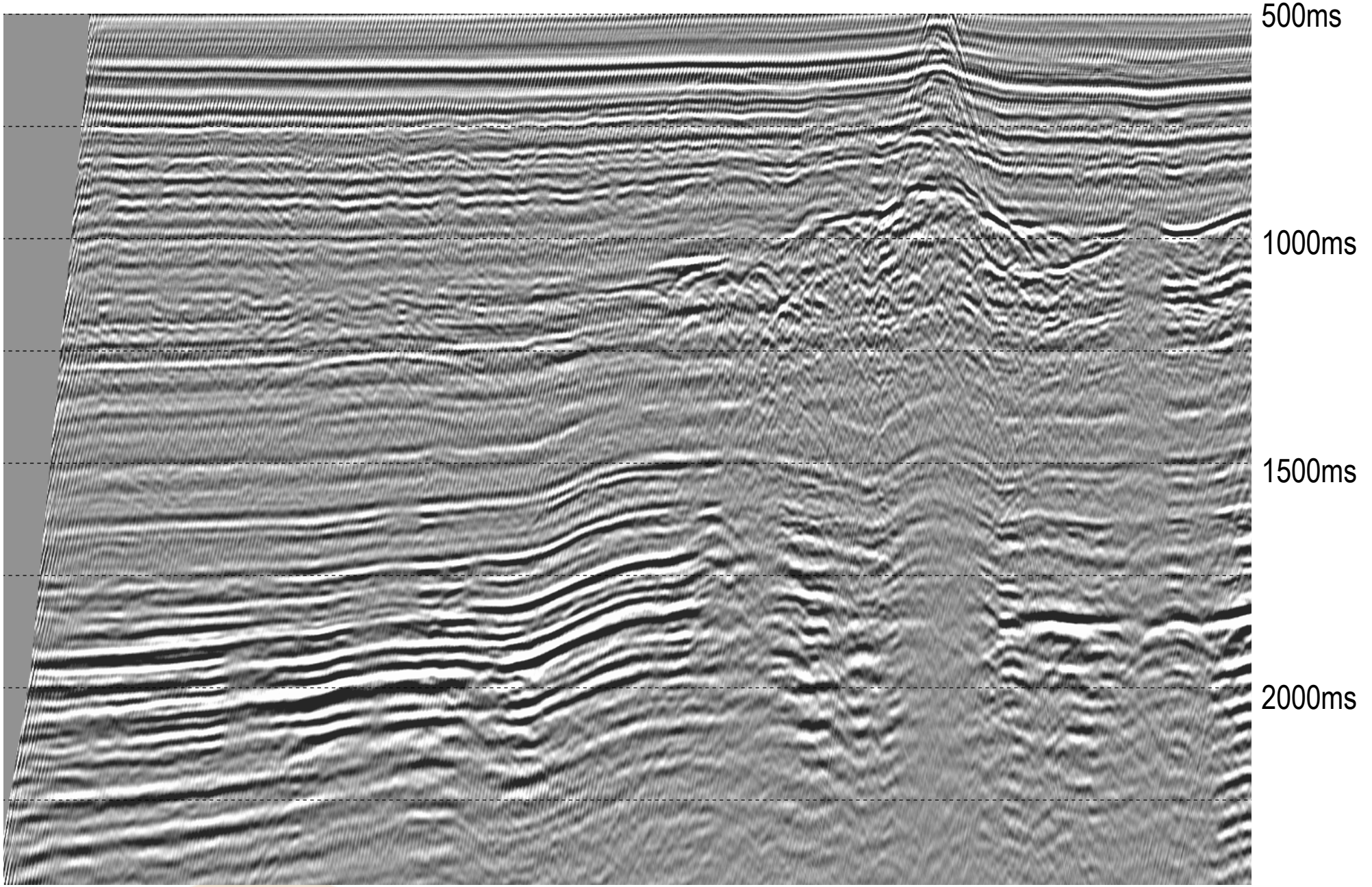
Interpolated CDPs - after dip filter



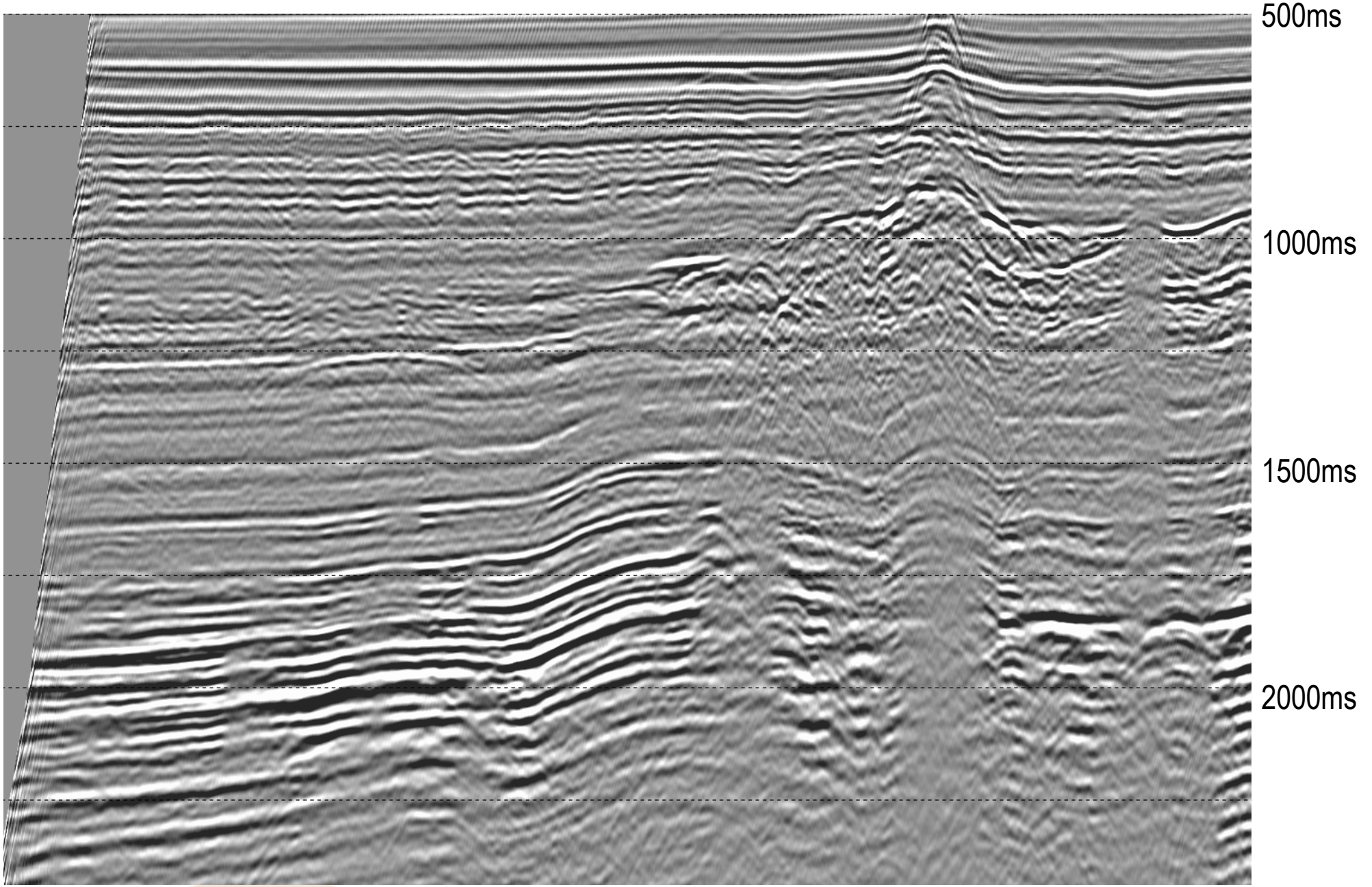
Interpolated CDPs – dipping noise removed



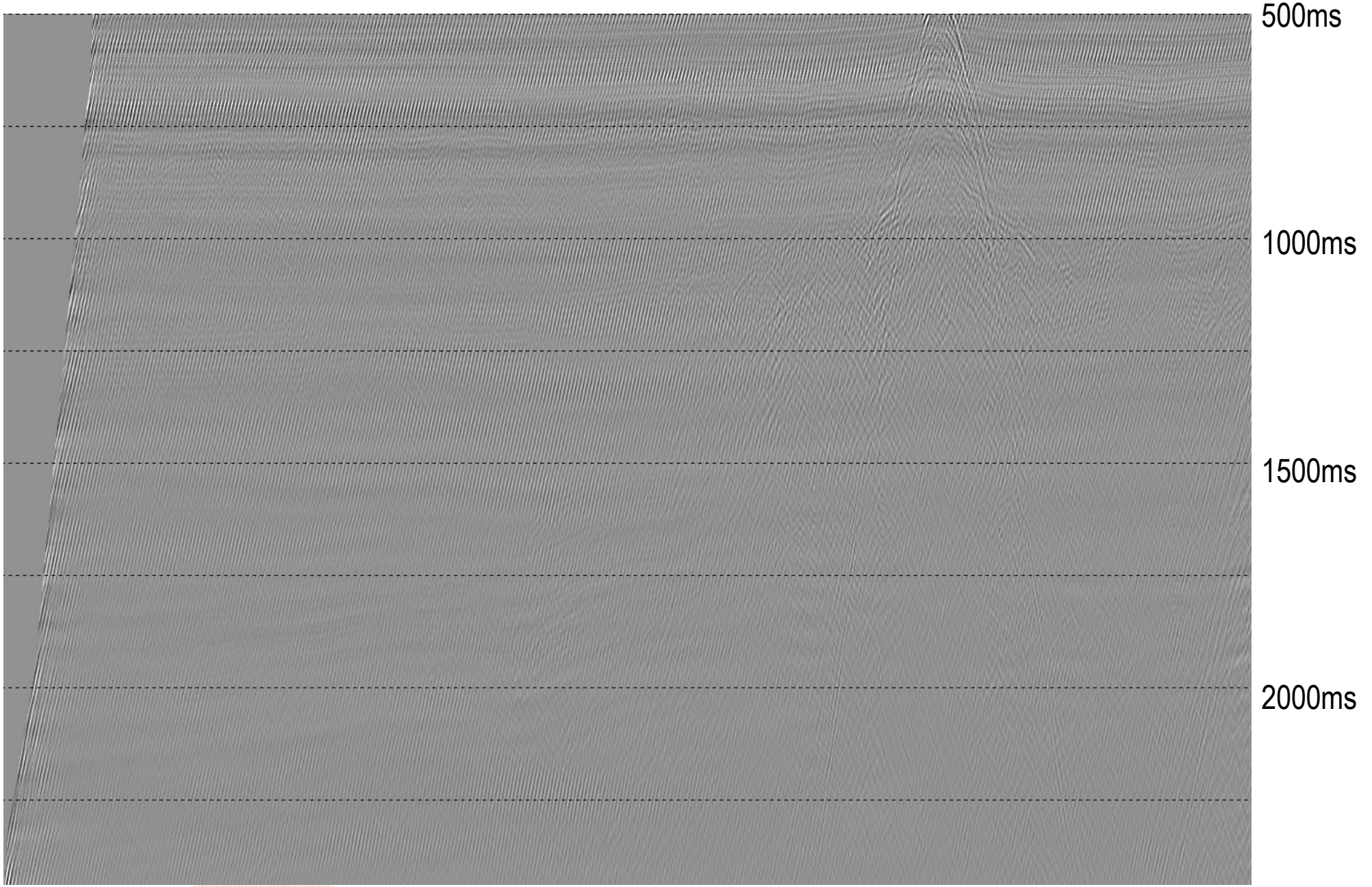
Stack – before dip filter



Stack – after dip filter



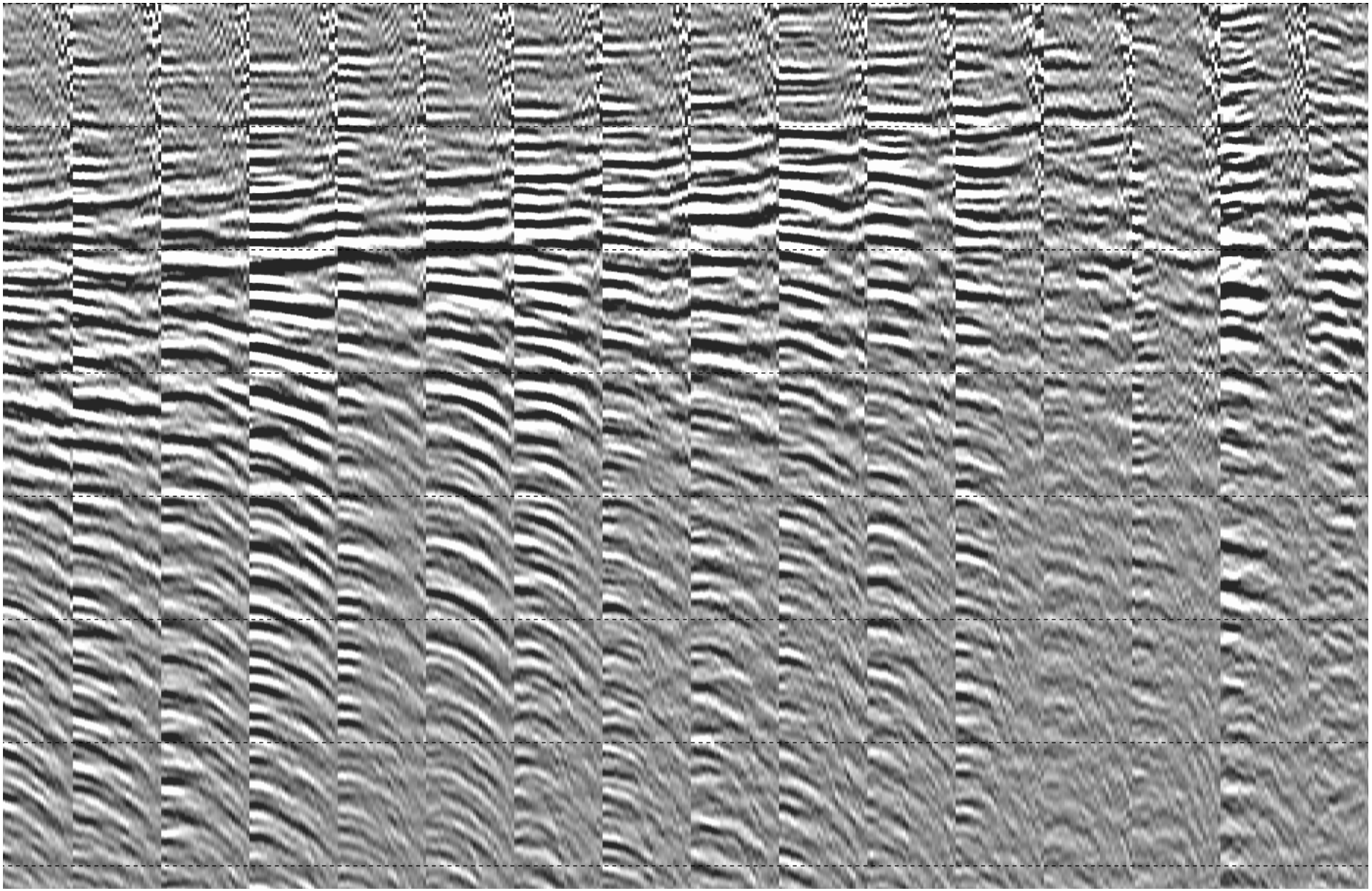
Stack – noise removed by dip filter



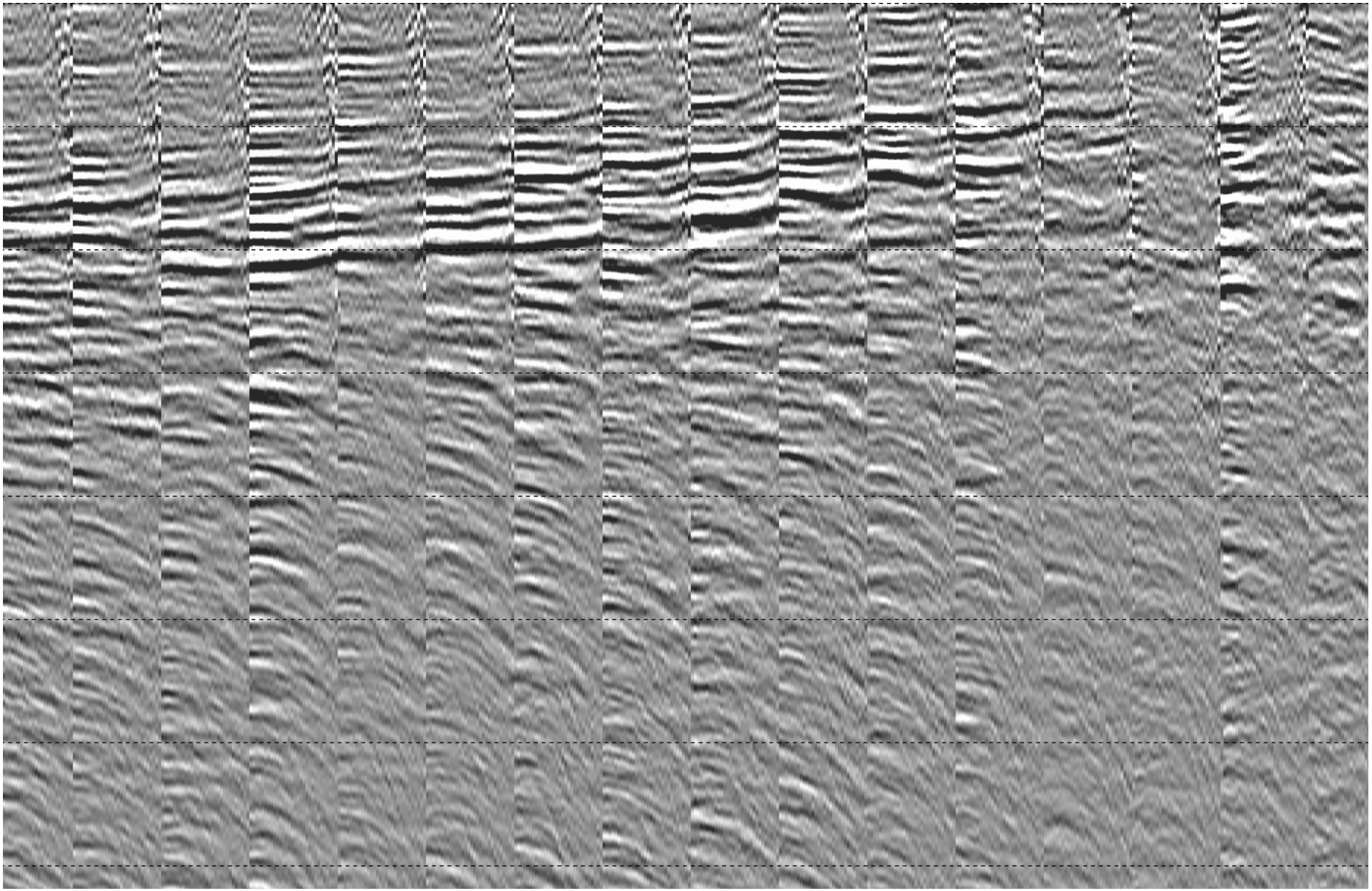
Tau-P Domain Deconvolution

- Tau-P deconvolution tests were run on their own and compared with SRME and also run after SRME. Each of the two methods were beneficial and the combination of the two methods resulted in more efficient multiple attenuation.
  - Gaps of 32 and 42ms, and operator lengths of 320ms and 600ms were tested.
  - A gap of 32ms and an operator of 320ms gave the optimum results. (It must be noted that the differences were quite small).

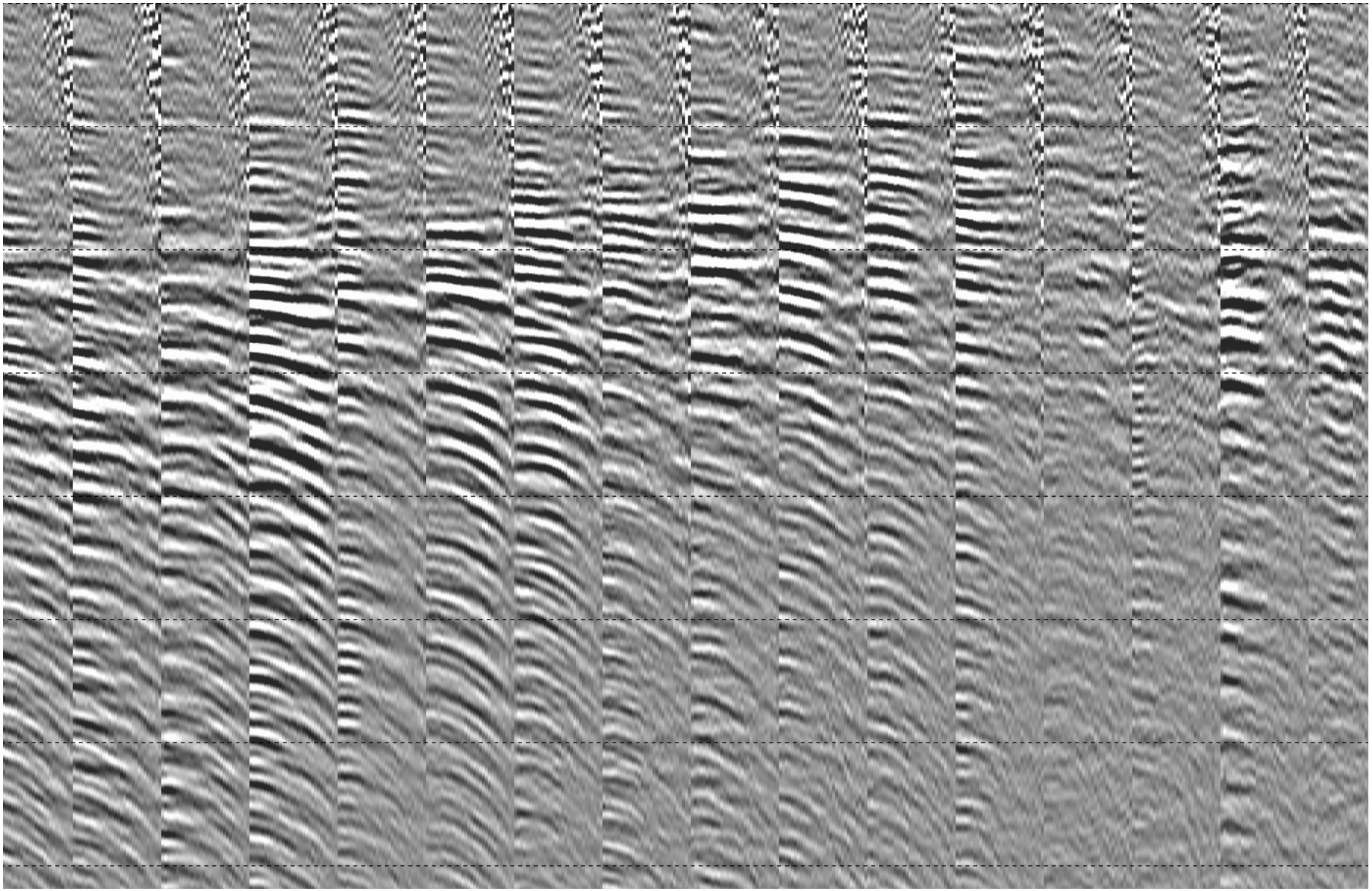
CDP – before Tau-P deconvolution (Gap: 32ms)



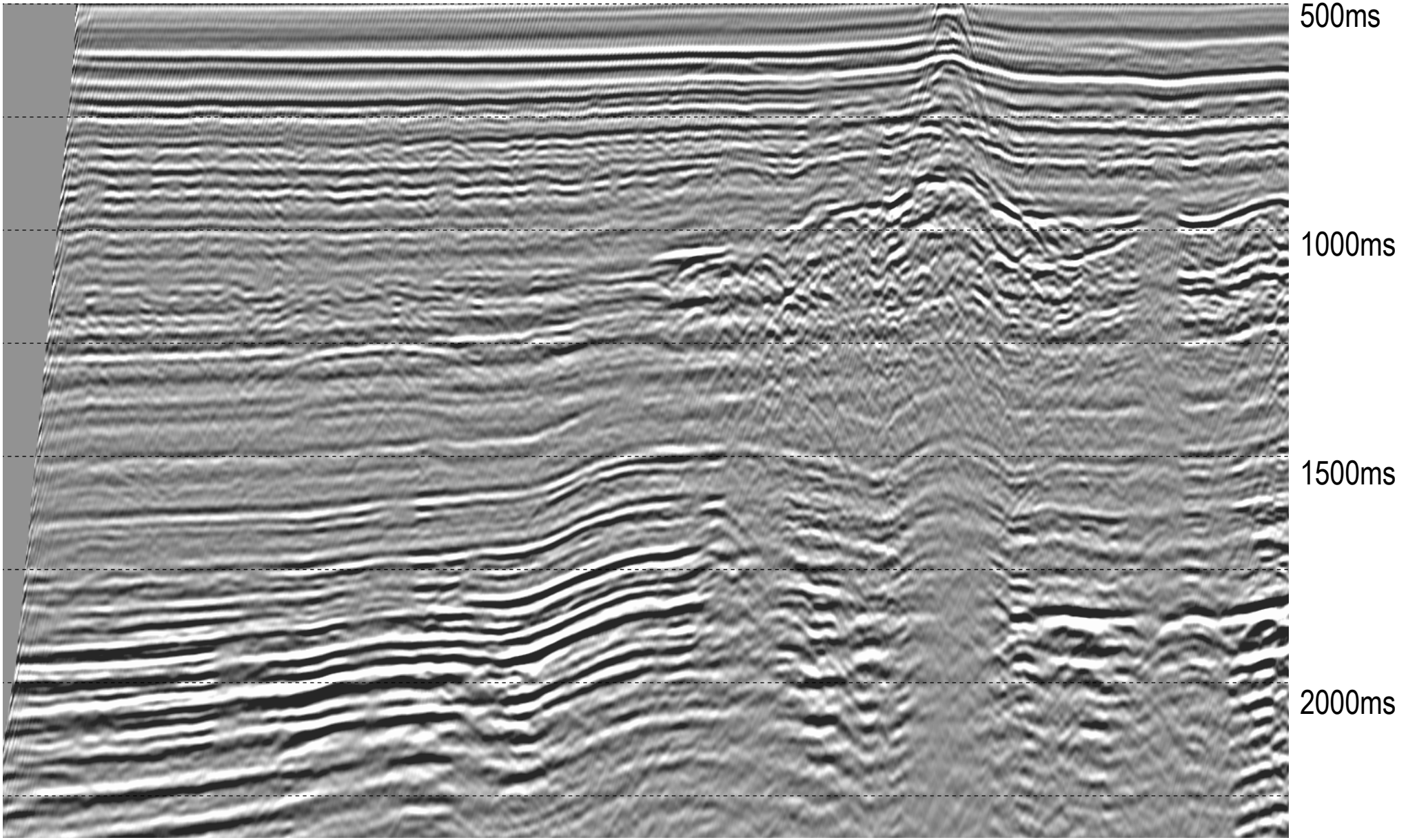
CDP – after Tau-P deconvolution (Gap: 32ms)



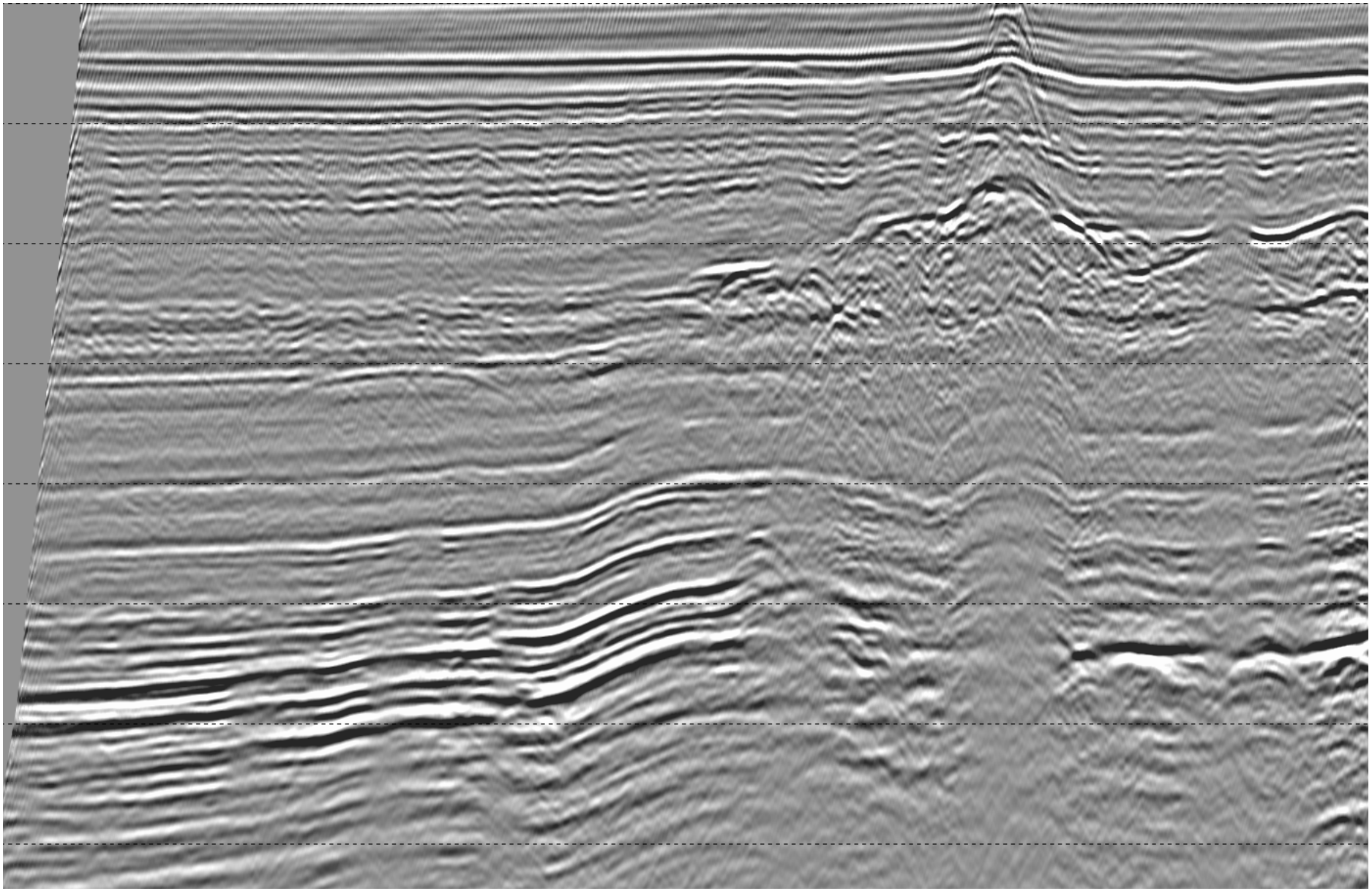
CDP – noise removed by Tau-P decon (Gap:32ms)



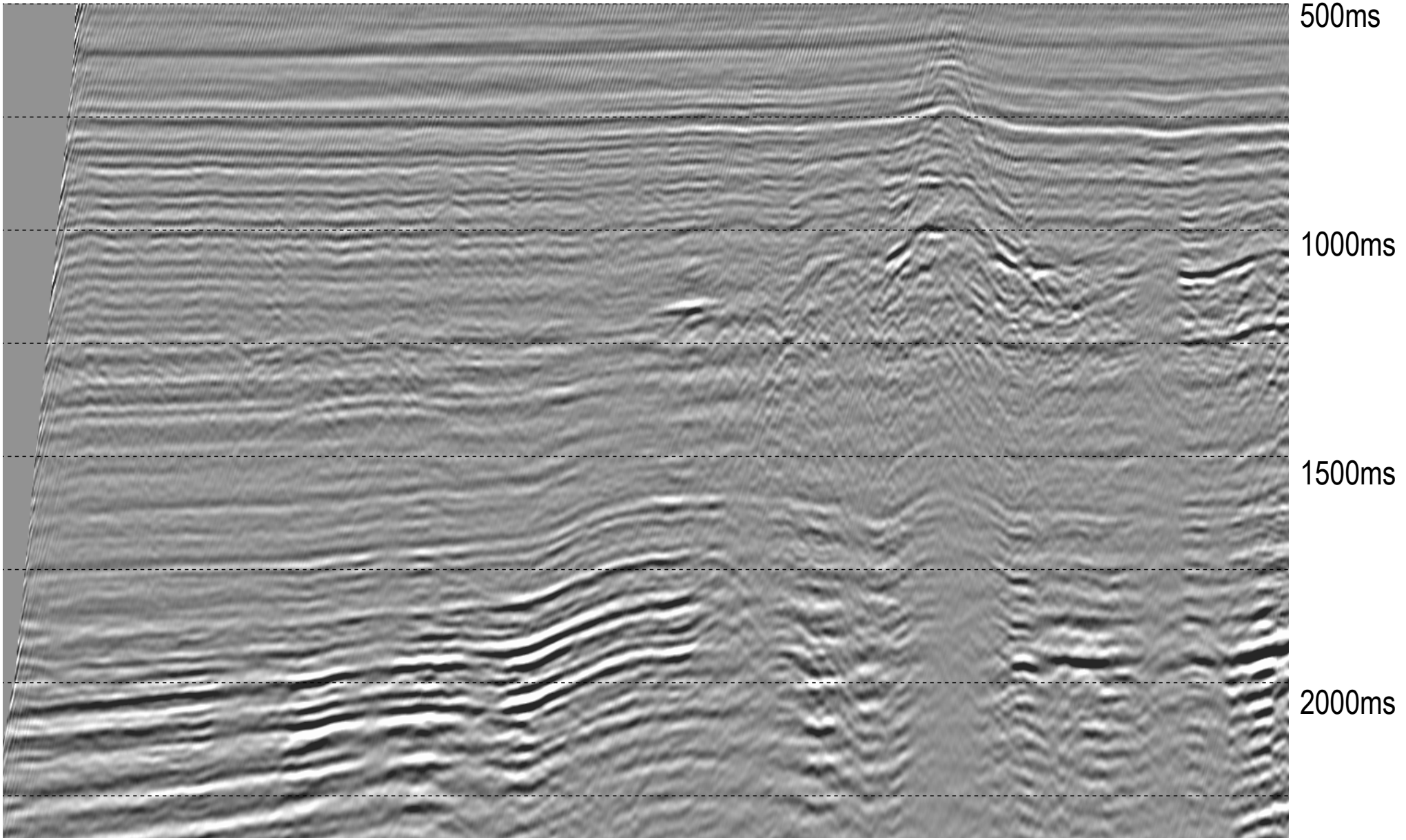
Stack – before Tau-P deconvolution (Gap: 32ms)



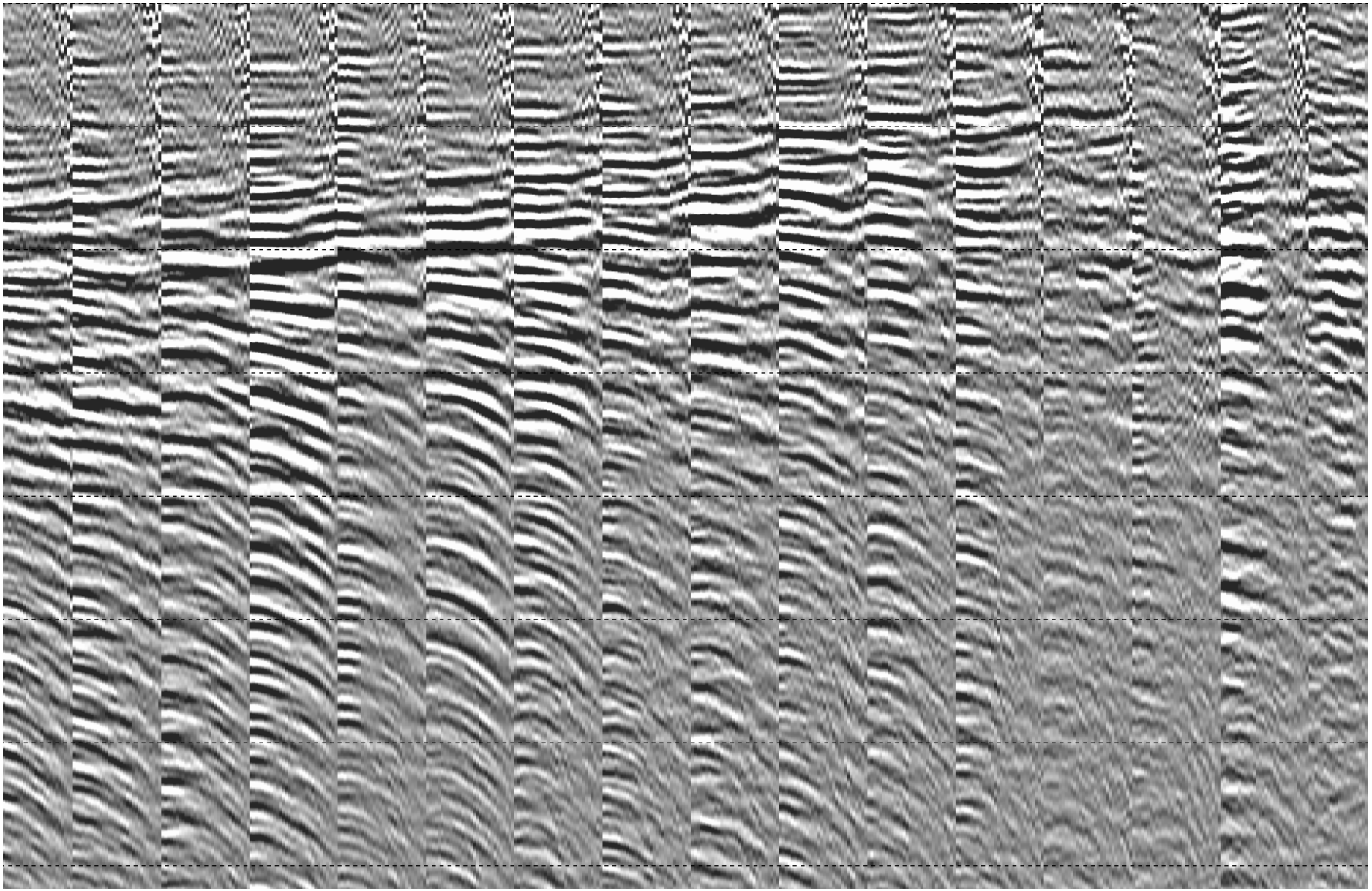
Stack – after Tau-P deconvolution (Gap: 32ms)



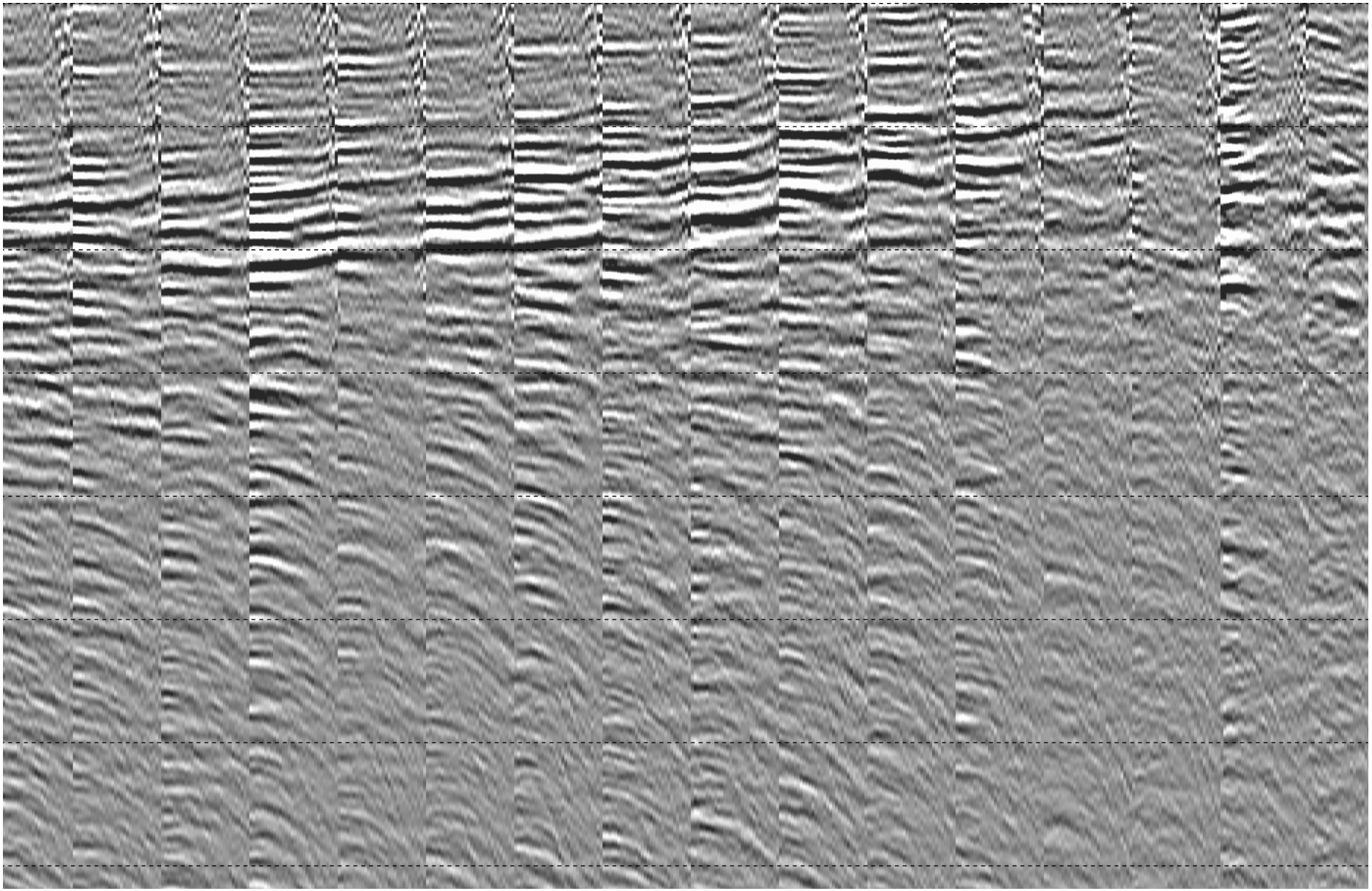
Noise removed by Tau-P deconvolution



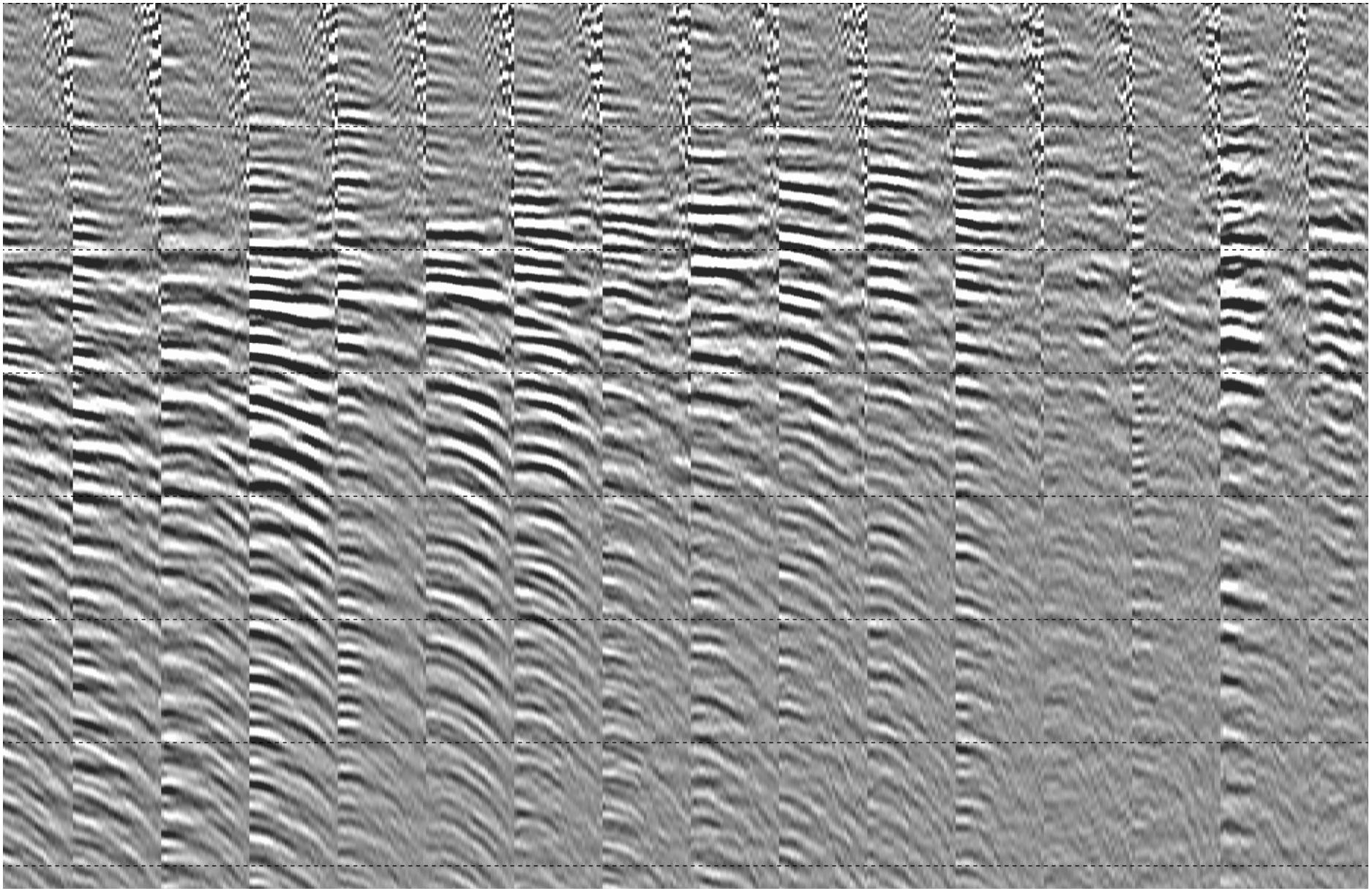
CDP – before Tau-P deconvolution (Gap: 42ms)



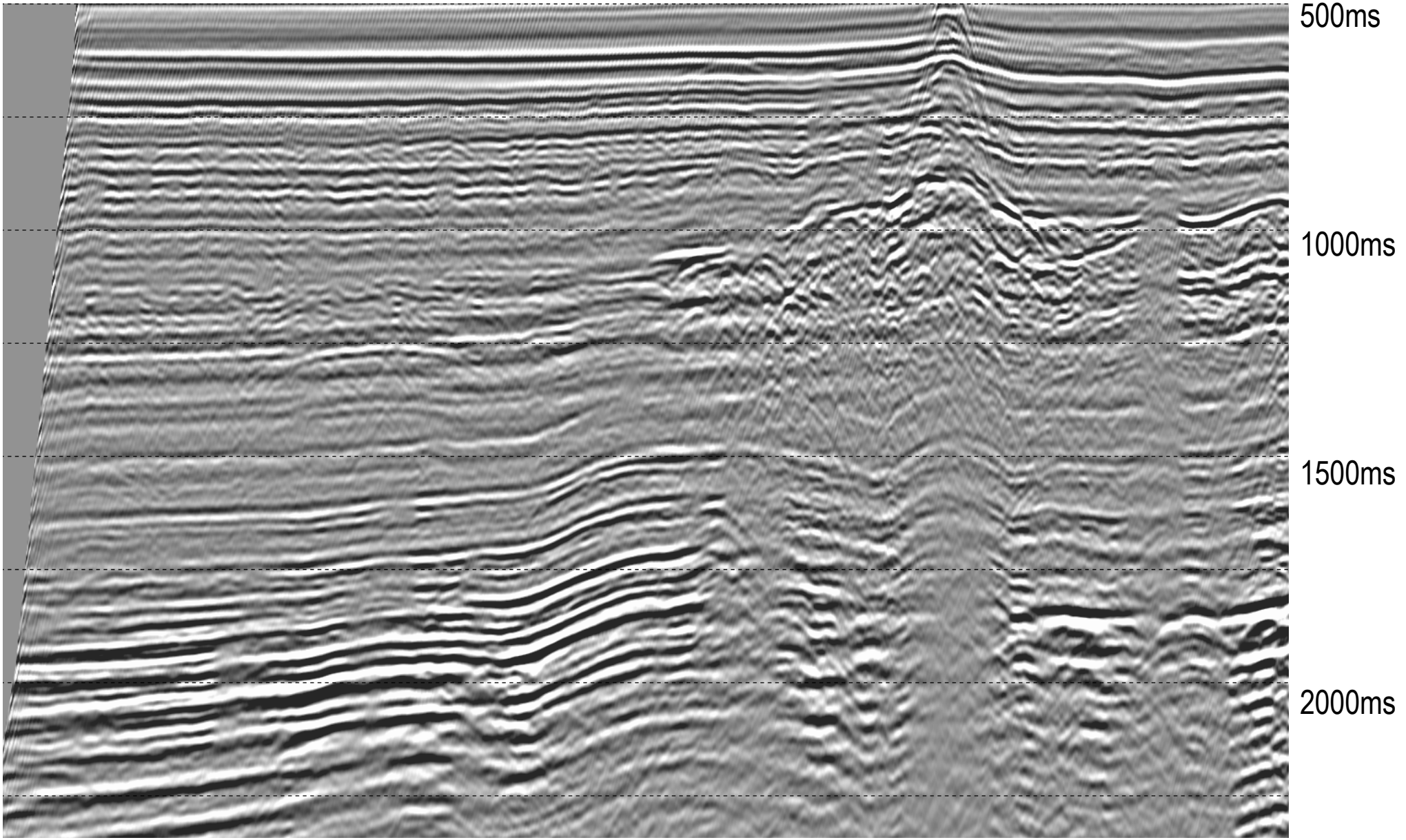
CDP – after Tau-P deconvolution (Gap: 42ms)



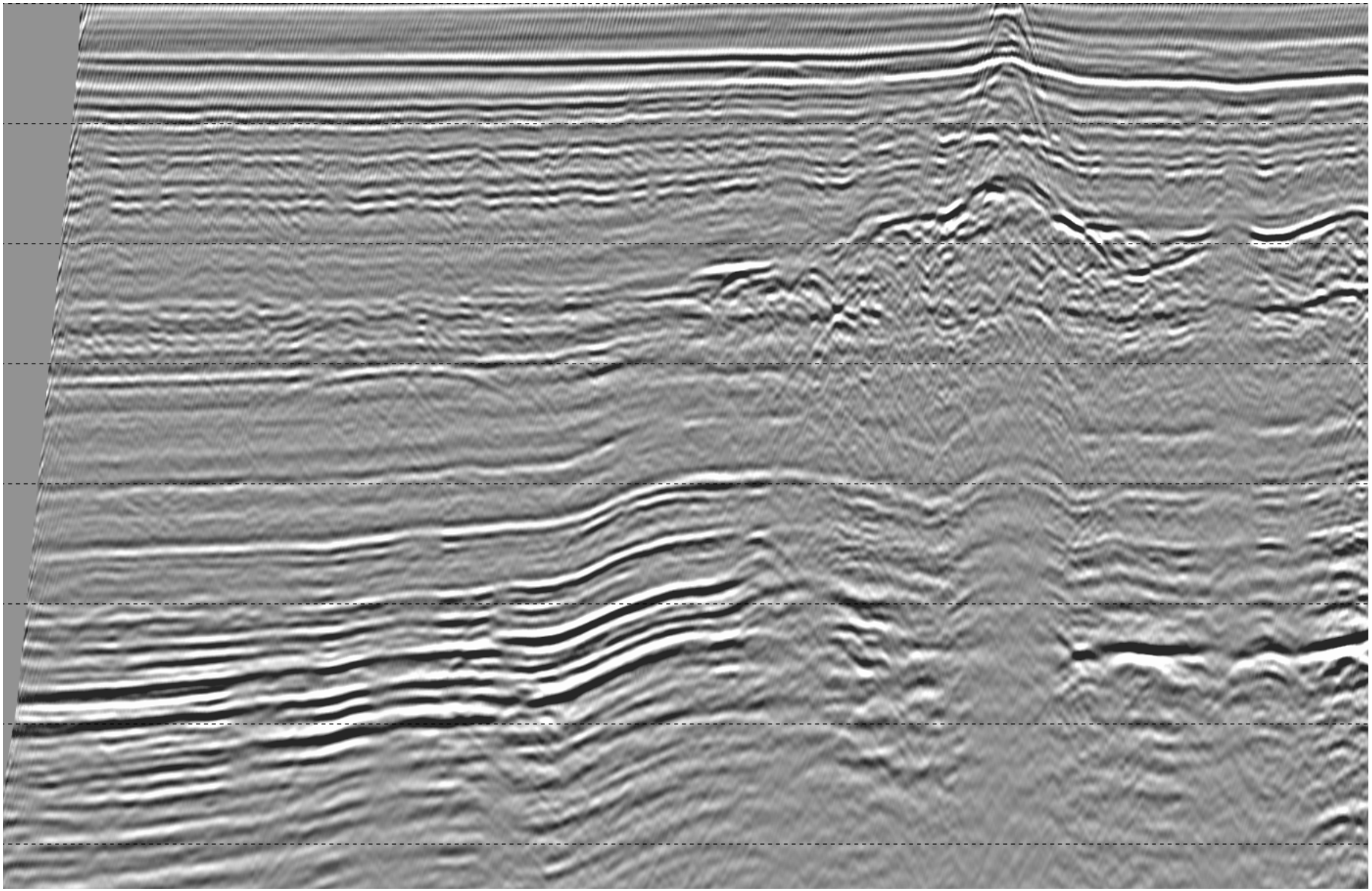
CDP – noise removed by Tau-P decon (Gap: 42ms)



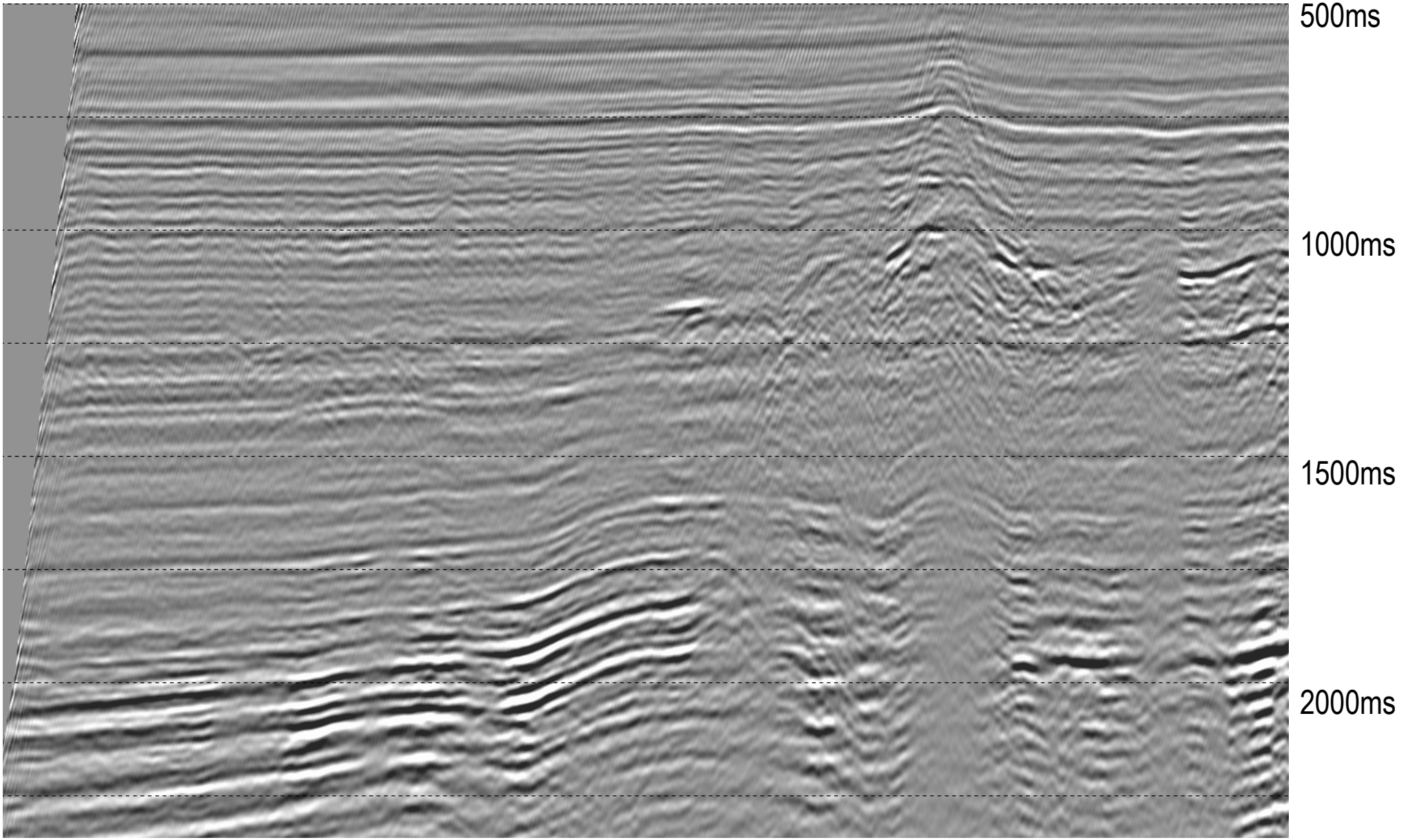
Stack – before Tau-P deconvolution (Gap: 42ms)



Stack – after Tau-P deconvolution (Gap: 42ms)



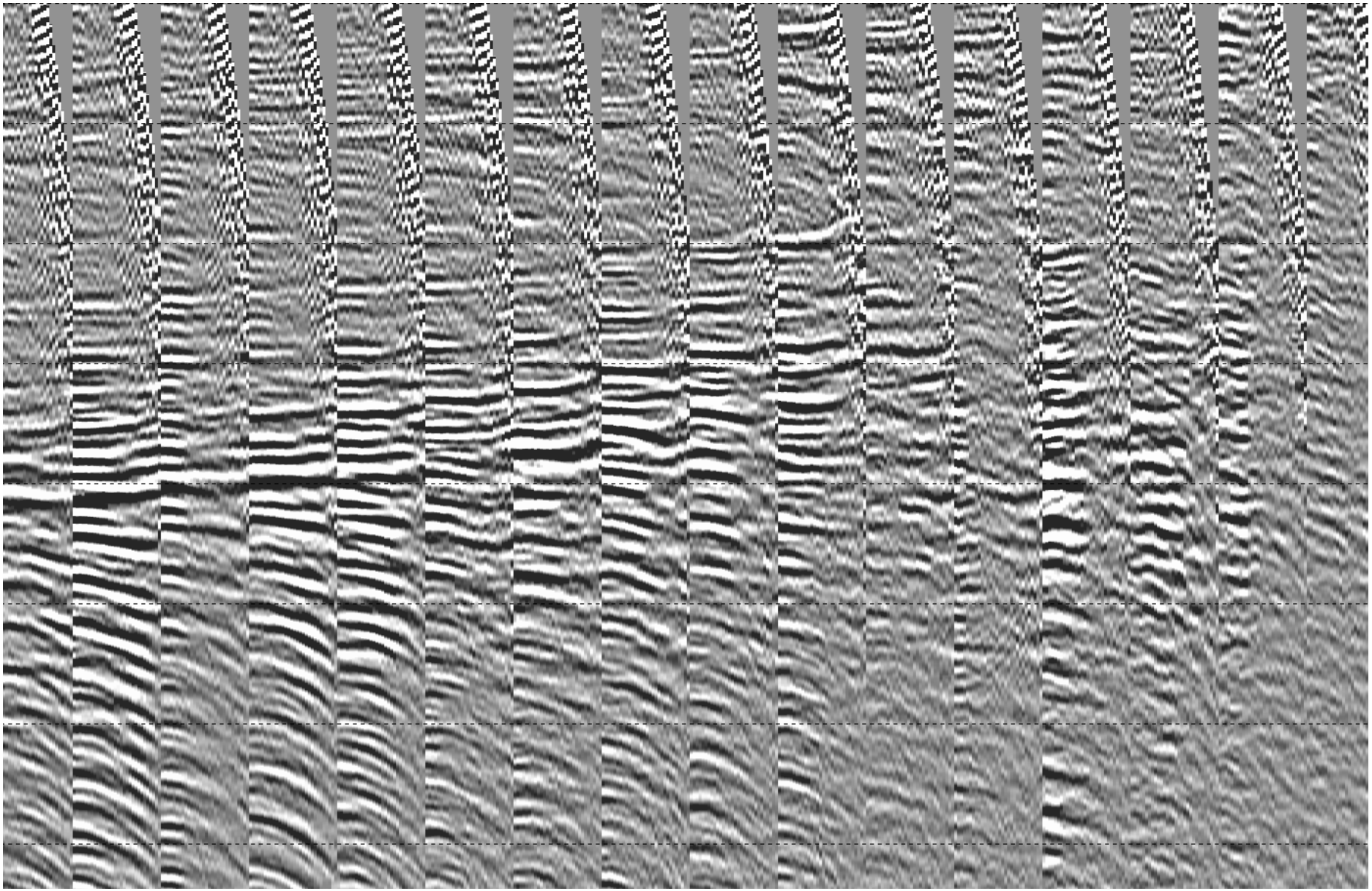
Noise removed by Tau-P deconvolution



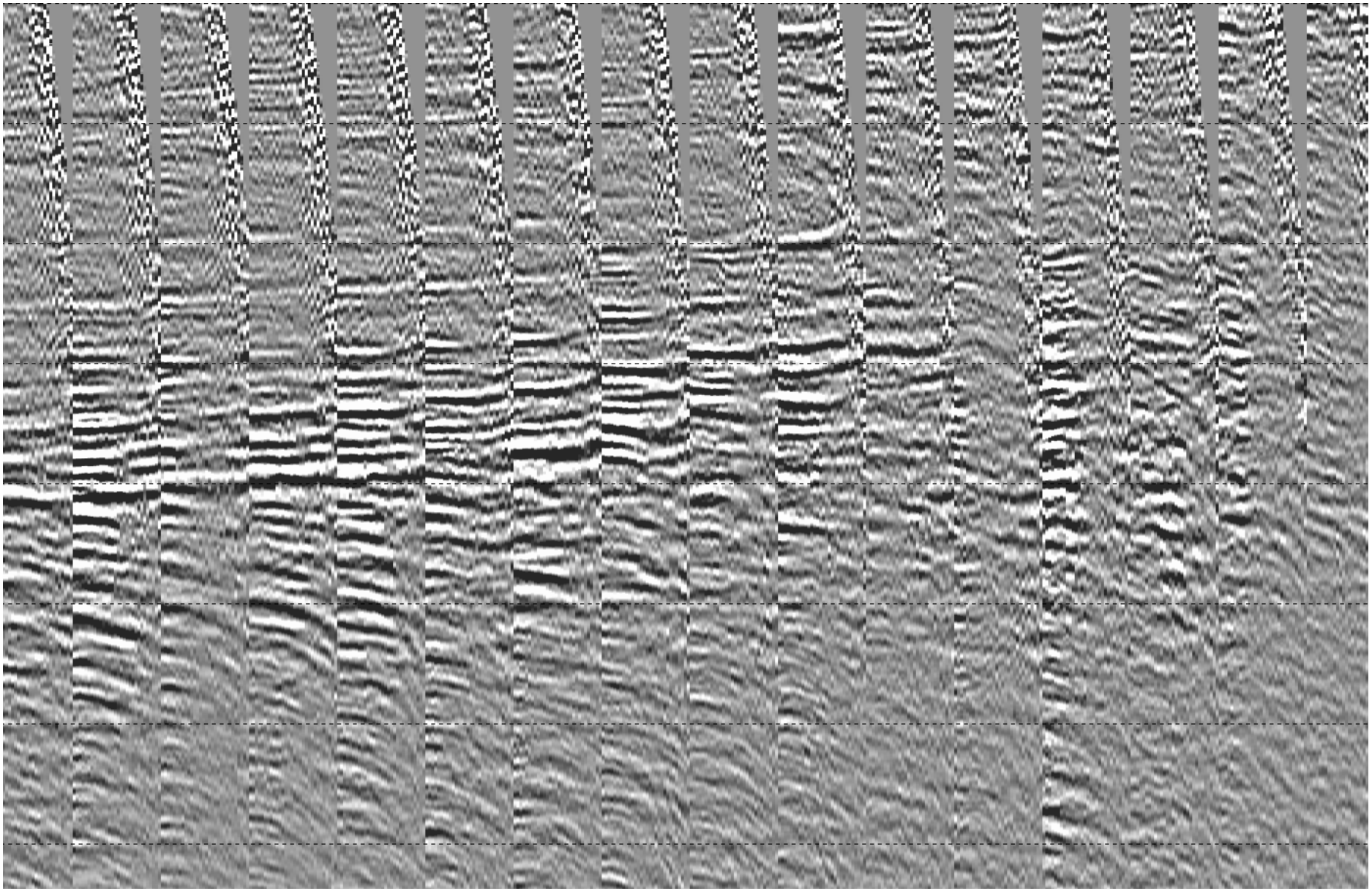
Surface Related Multiple Elimination

- Surface related multiples were modelled and adaptively subtracted from the data.
- Shotpoints were interpolated and the near trace extrapolated to zero offset before SRME.

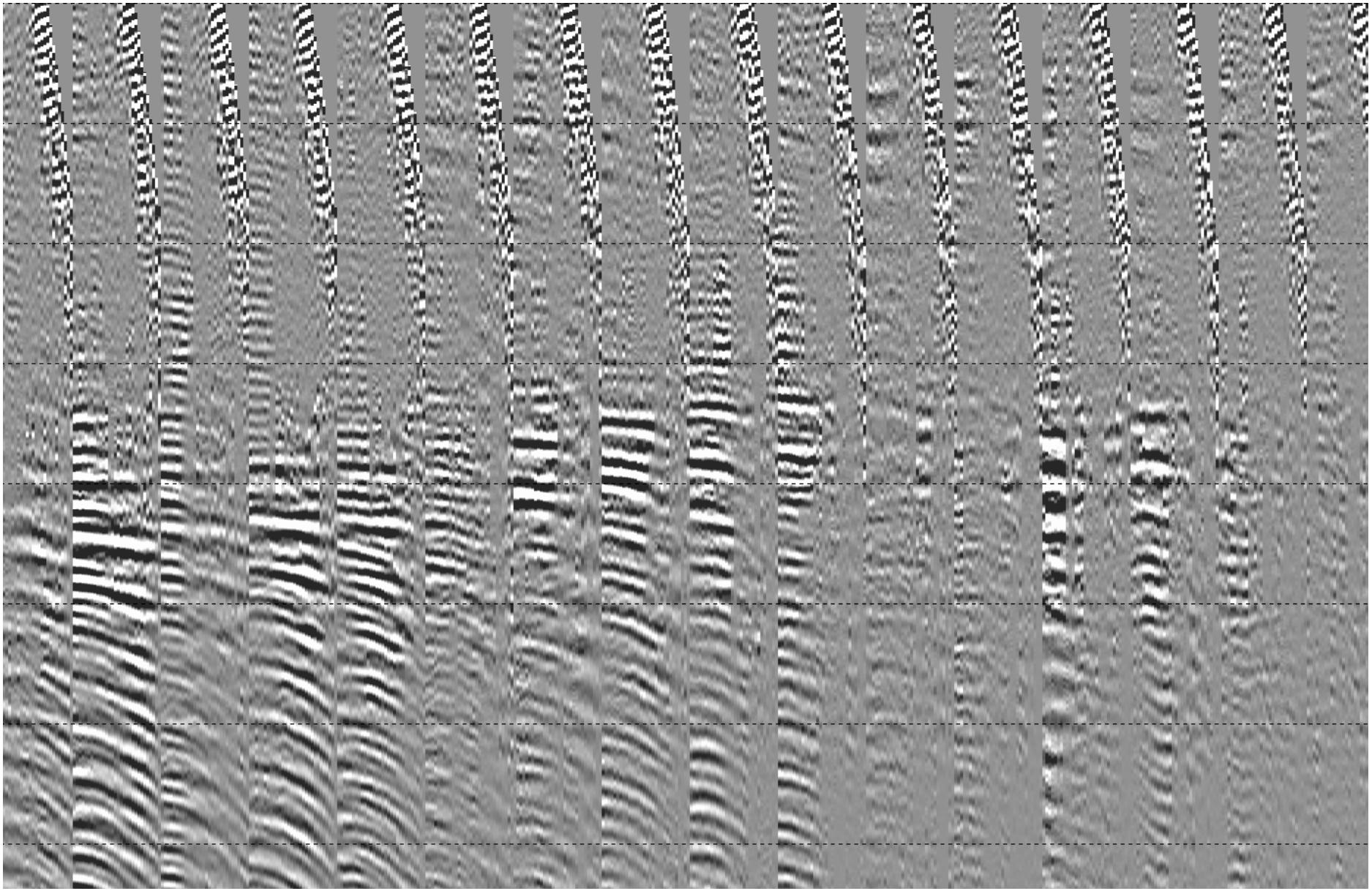
CDPs – before SRME



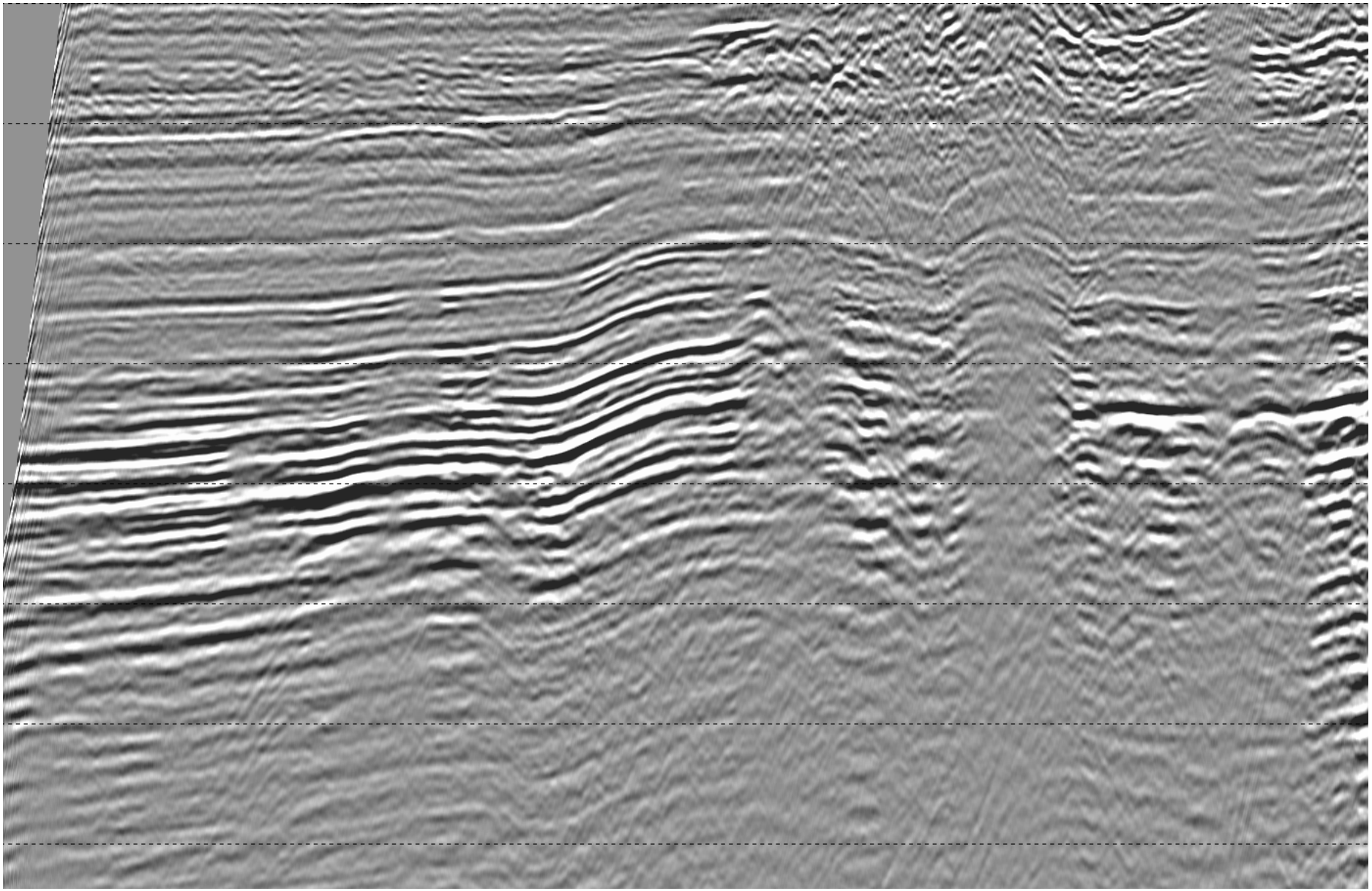
CDPs – after SRME



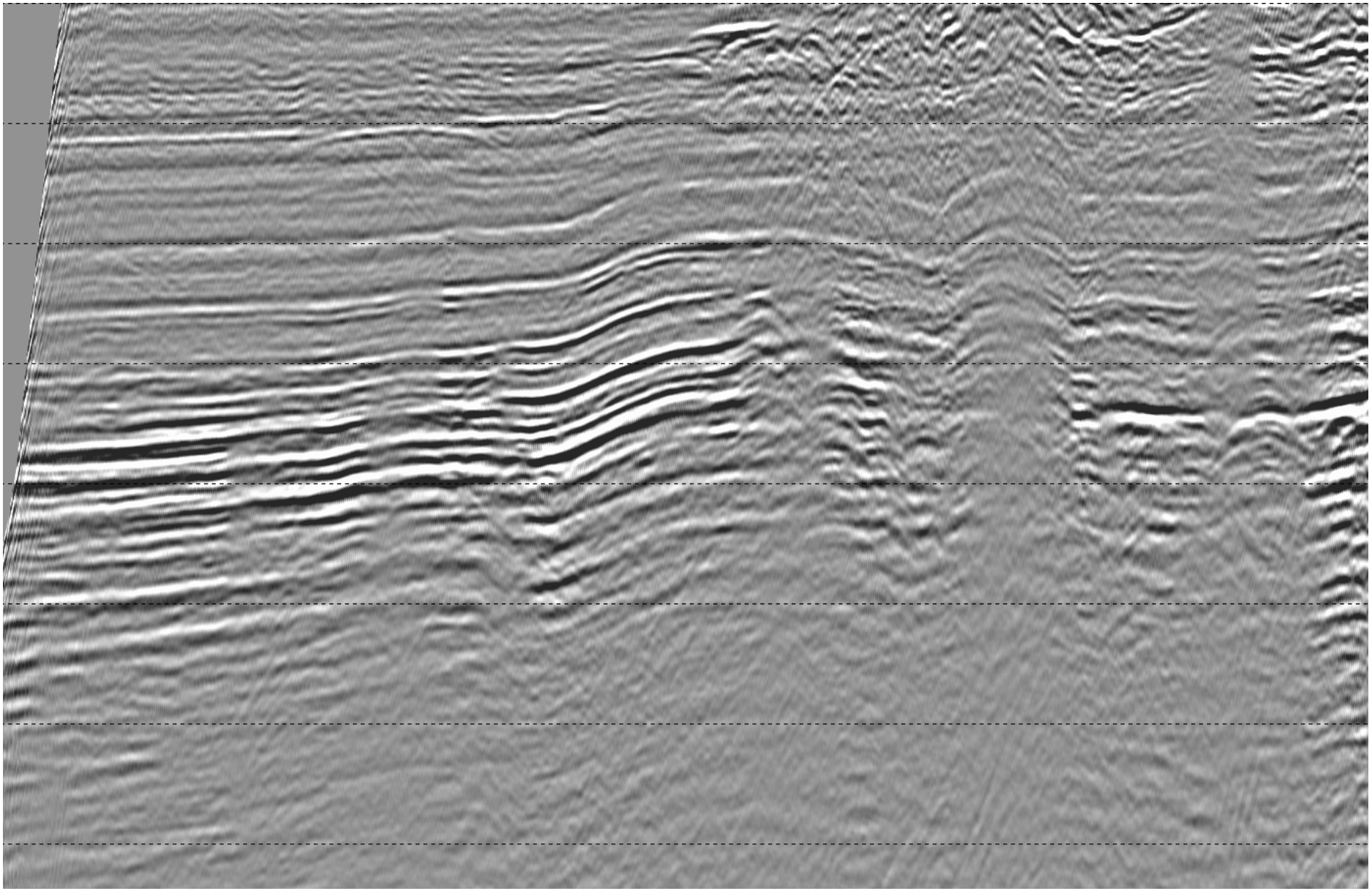
CDPs – Noise removed by SRME



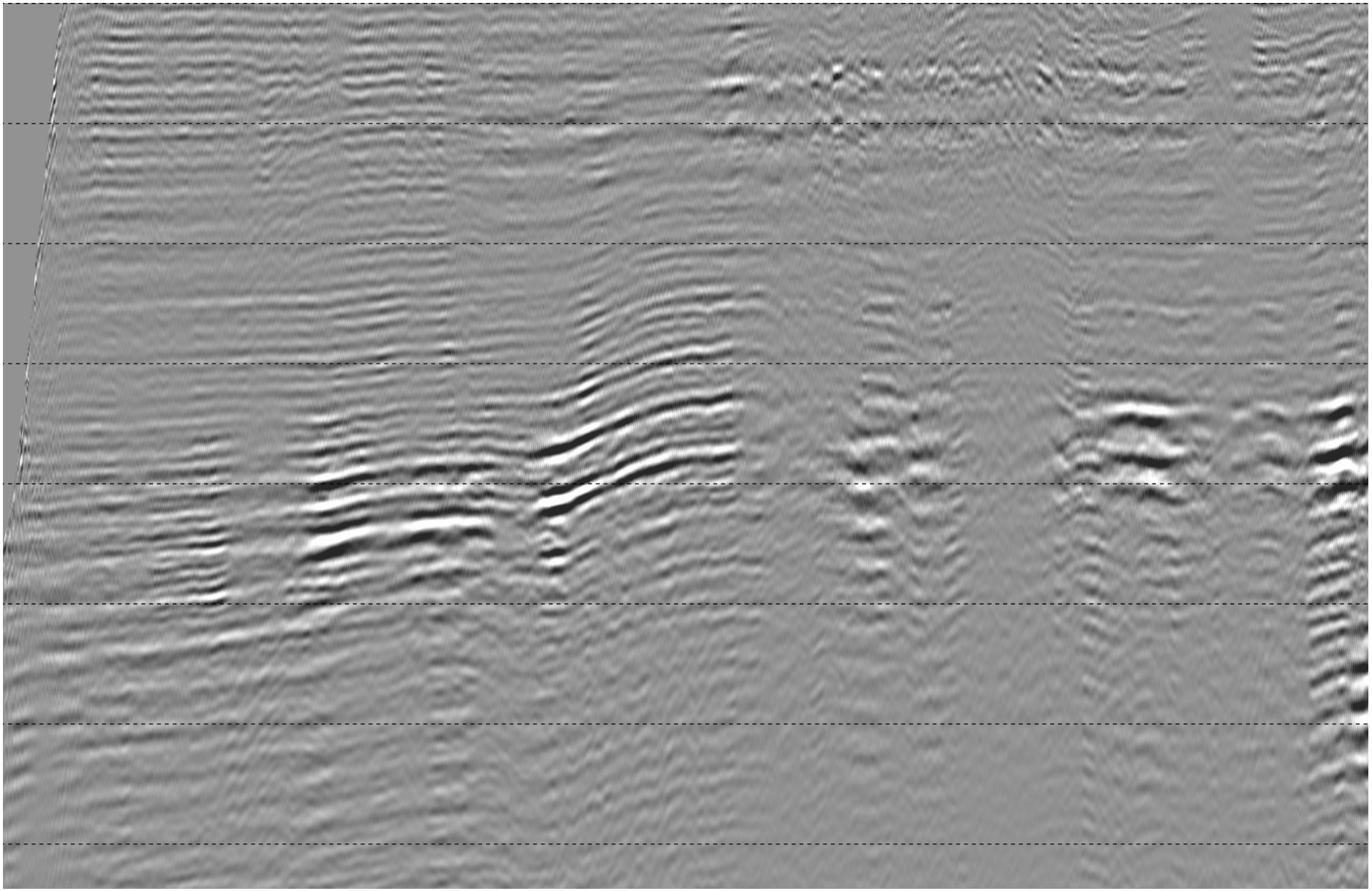
Stack – before SRME



Stack – after SRME



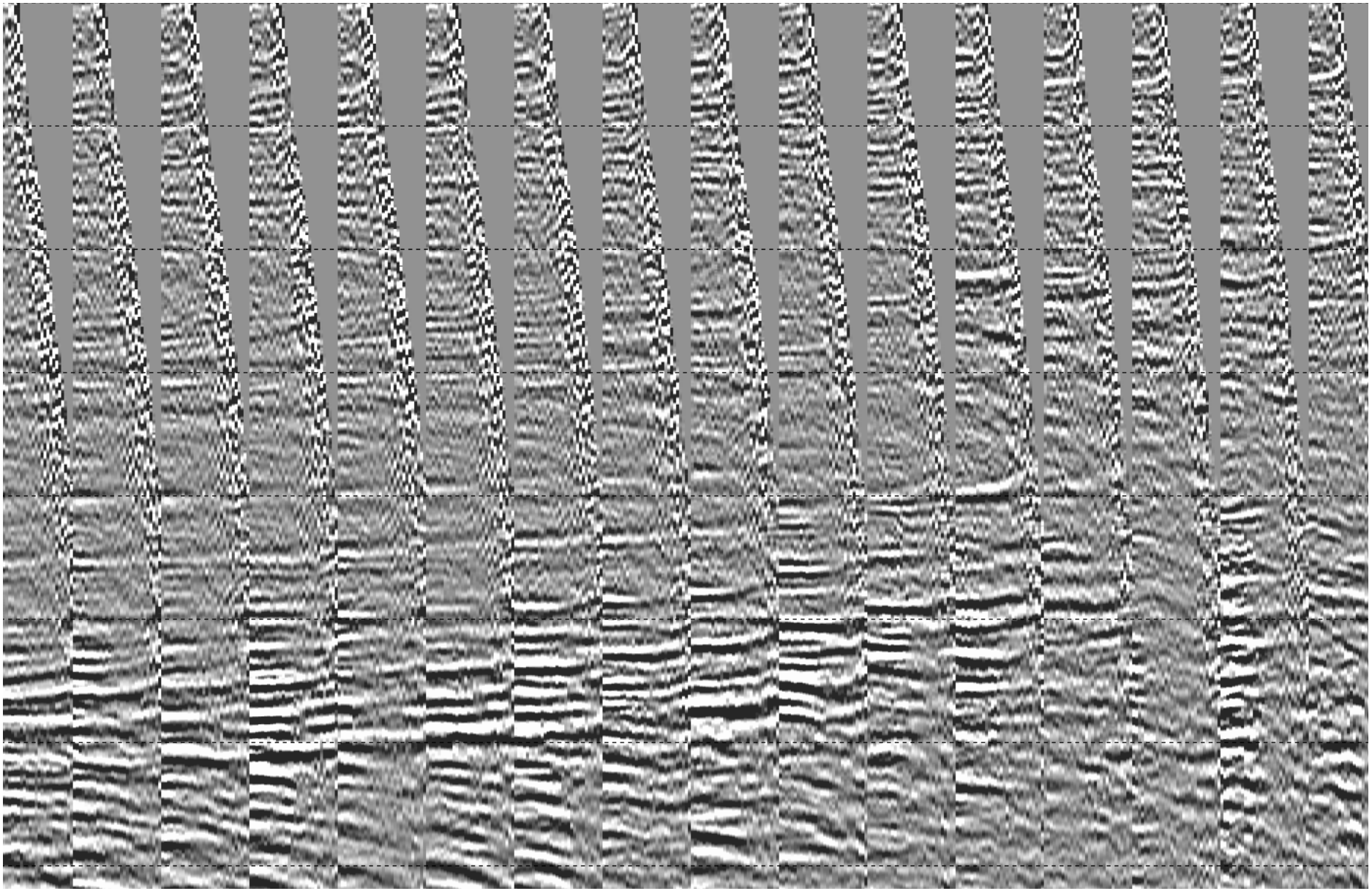
Stack – Noise removed by SRME



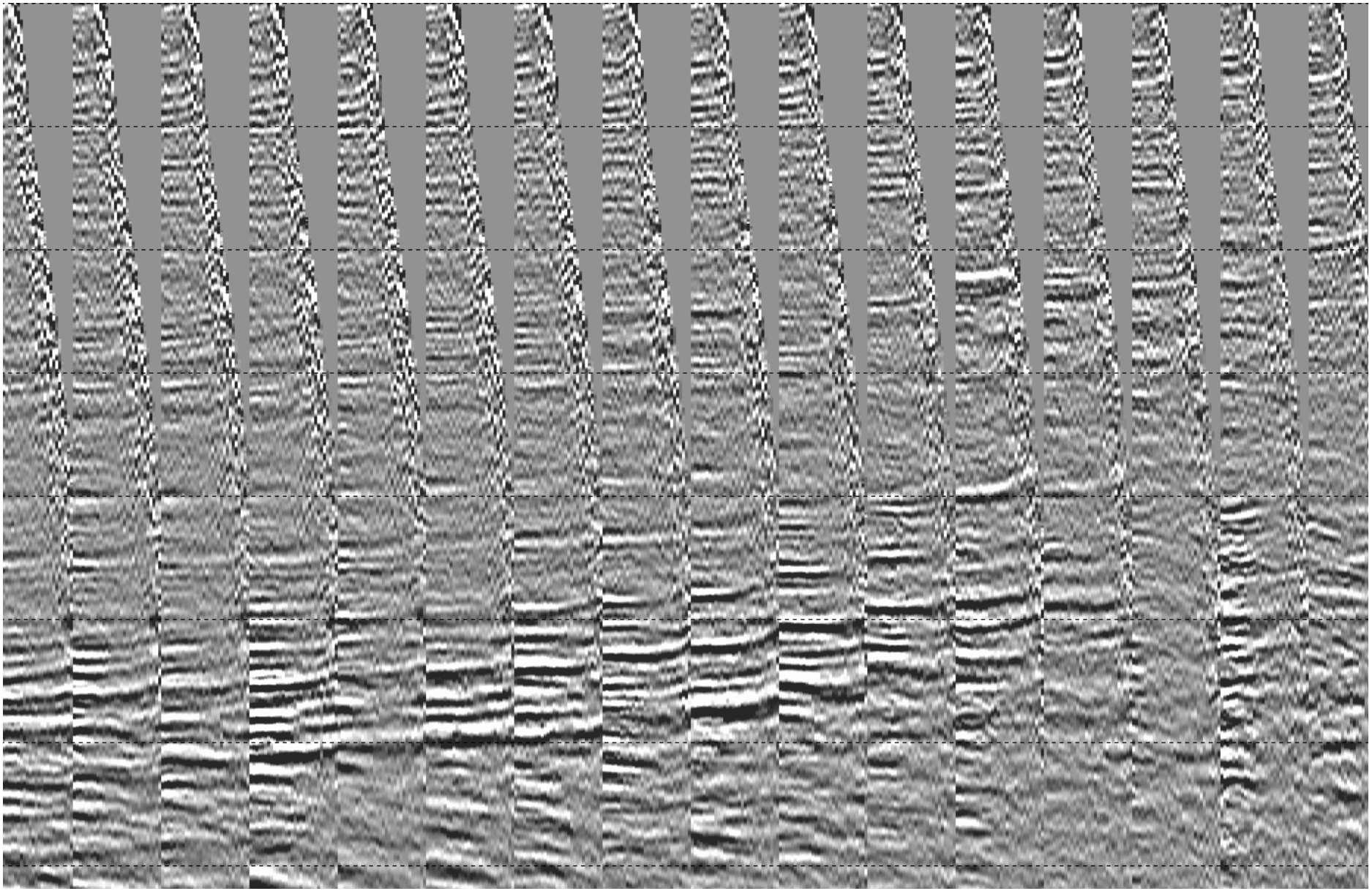
SRME and Tau-P deconvolution

- Application of Tau-P deconvolution after SRME resulted in a stacked section with less multiple energy in it.
- A mild mute was also applied in the Tau-P domain.
- Gaps tested:
  - 32ms
  - 42ms
- Operators tested:
  - 320ms
  - 600ms
- The 32ms gap with a 600ms operator was chosen as the parameters to use.

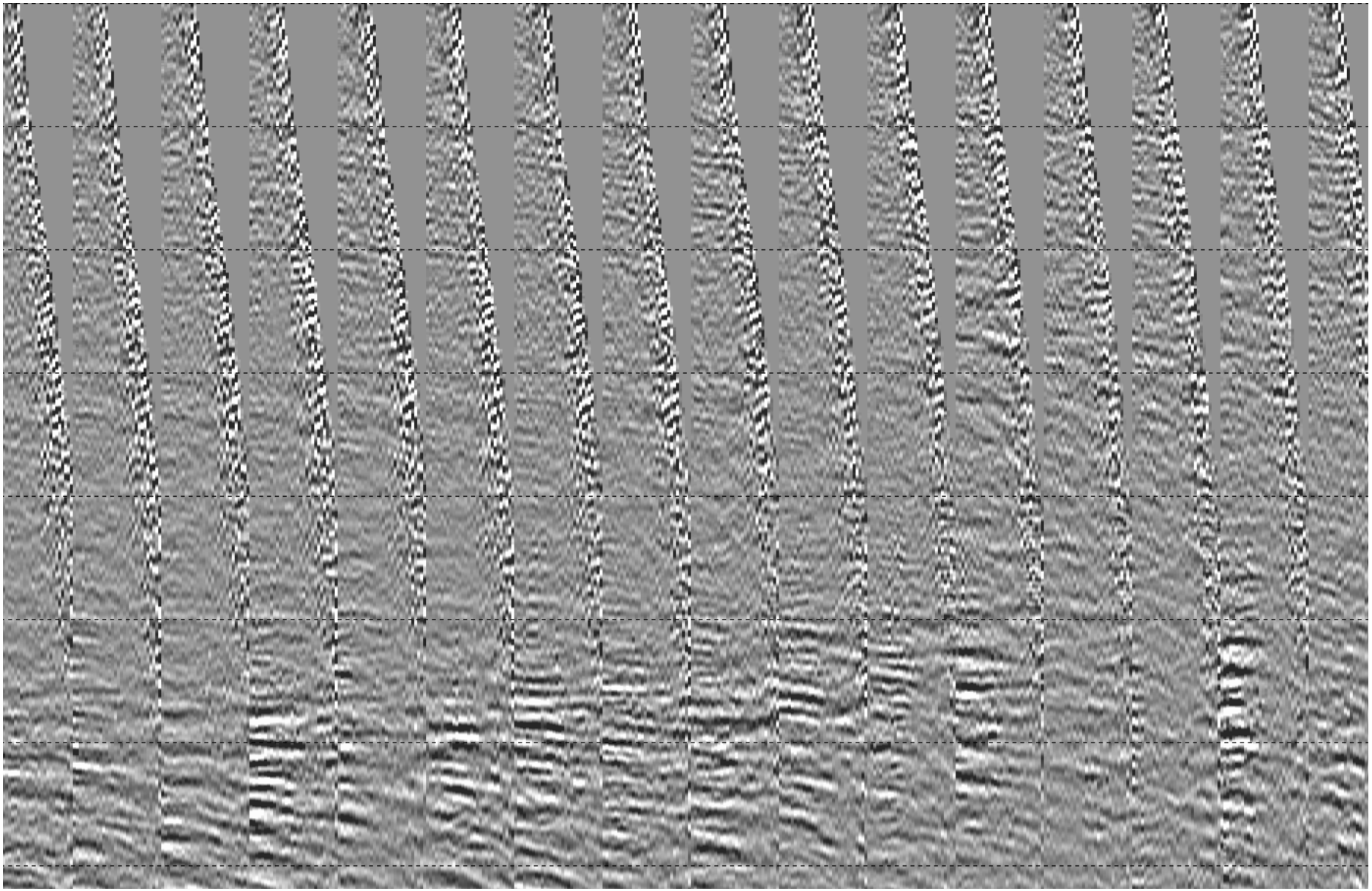
SRME CDPs – before TauP Decon



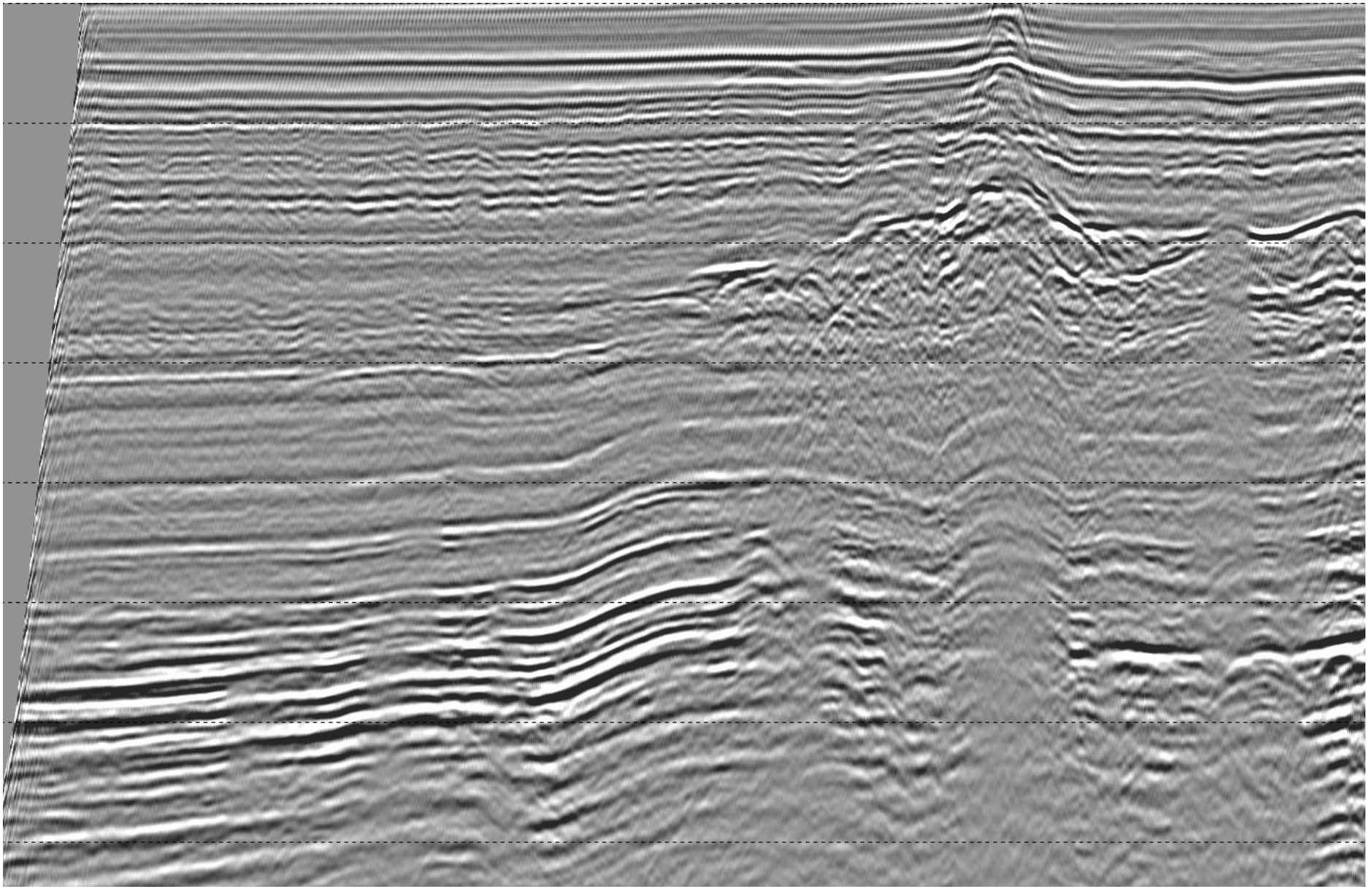
SRME CDPs – after TauP Decon (32ms gap)



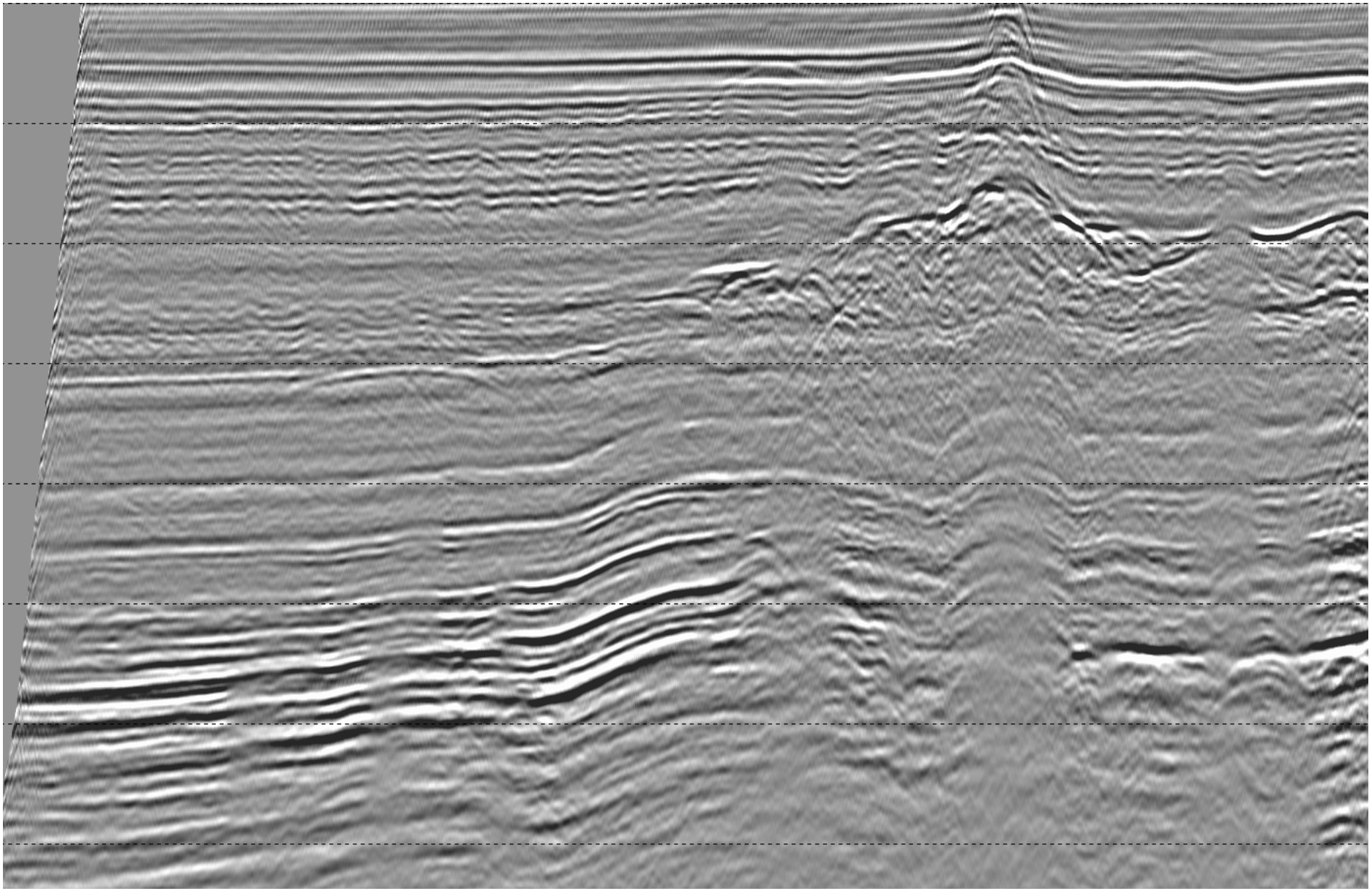
SRME CDPs – noise removed by TauP Decon



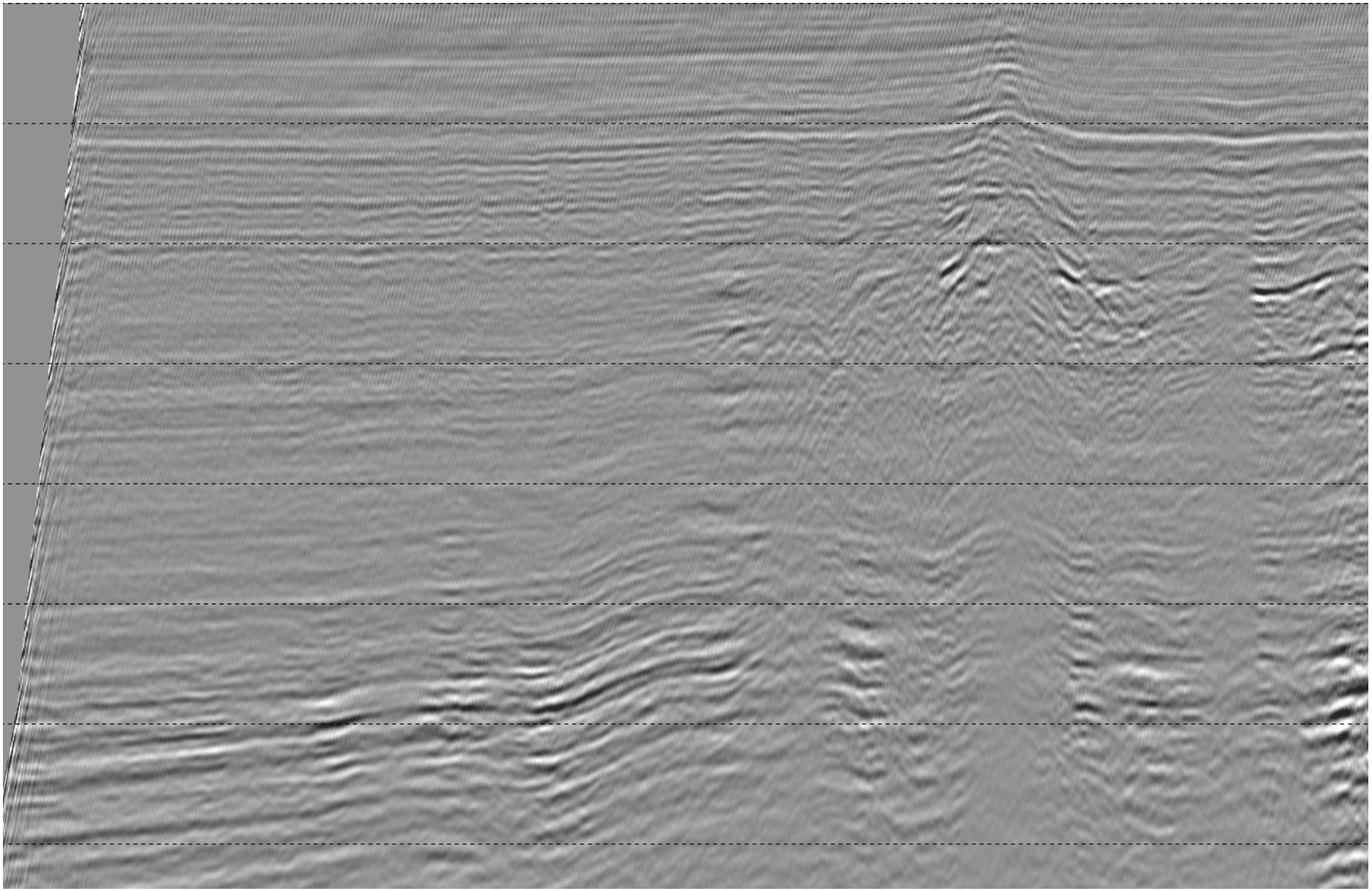
Stack – SRME only



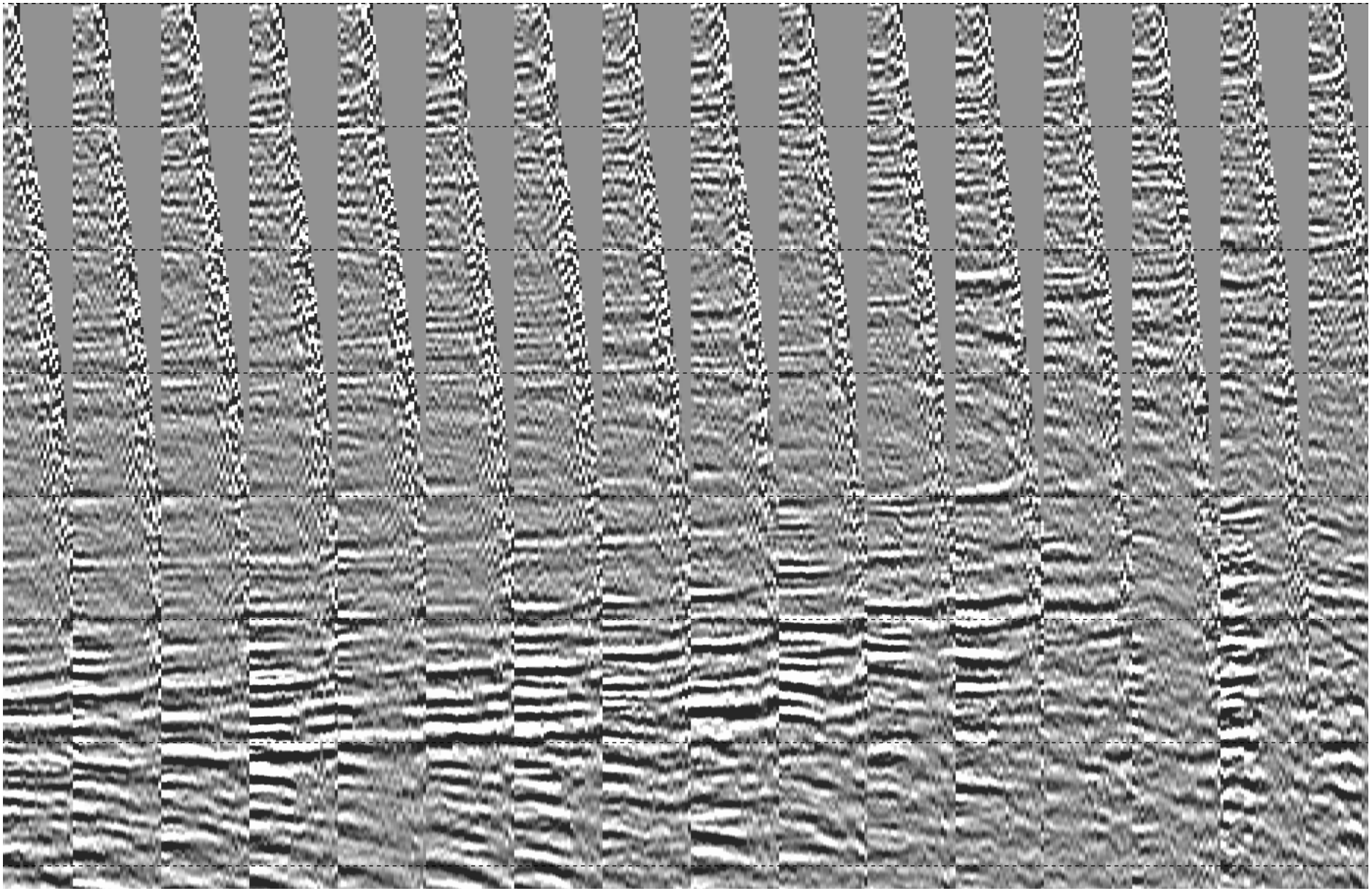
Stack – SRME and TauP Decon (32ms gap)



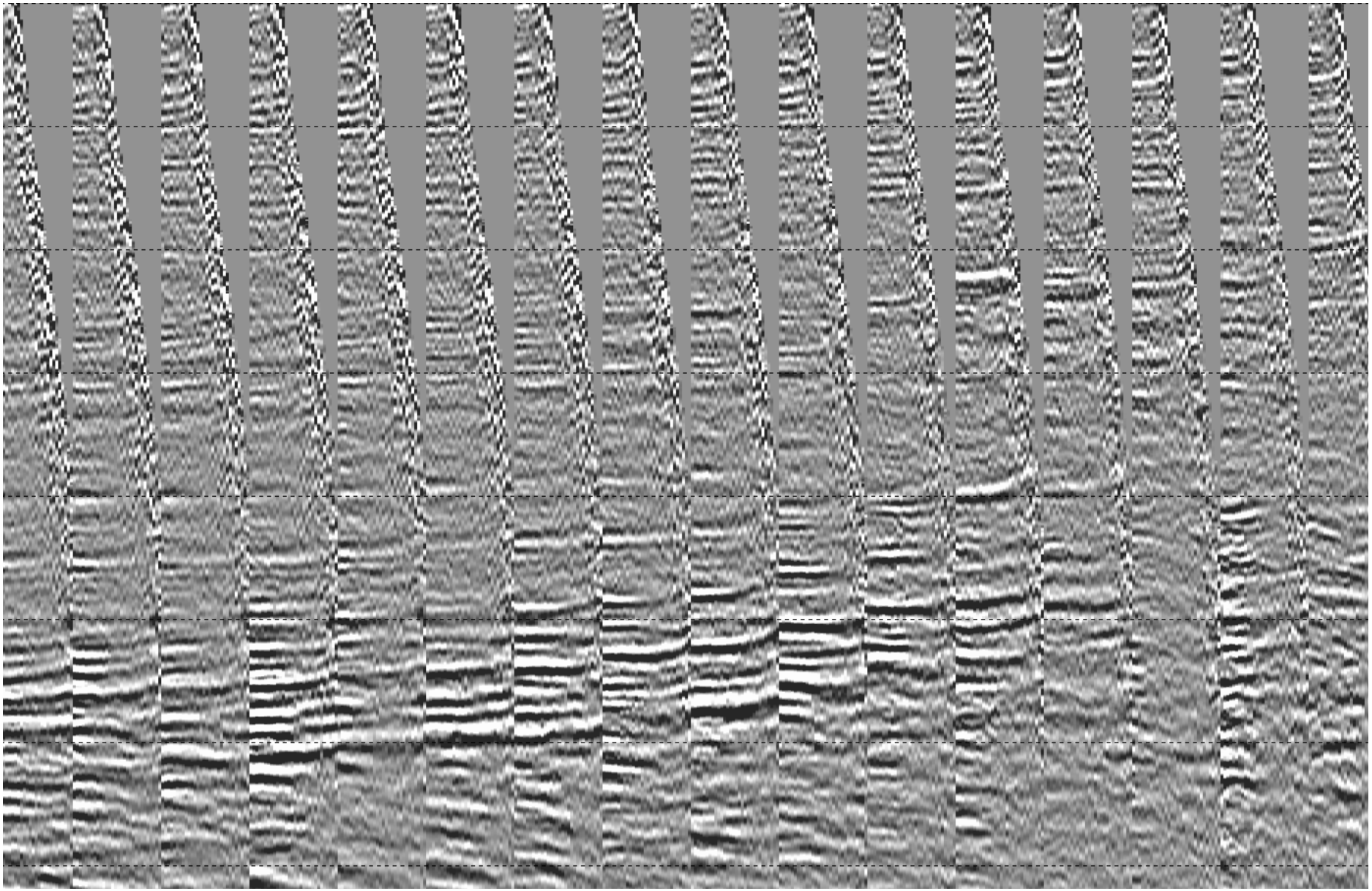
Stack – noise removed by TauP Decon (32ms gap)



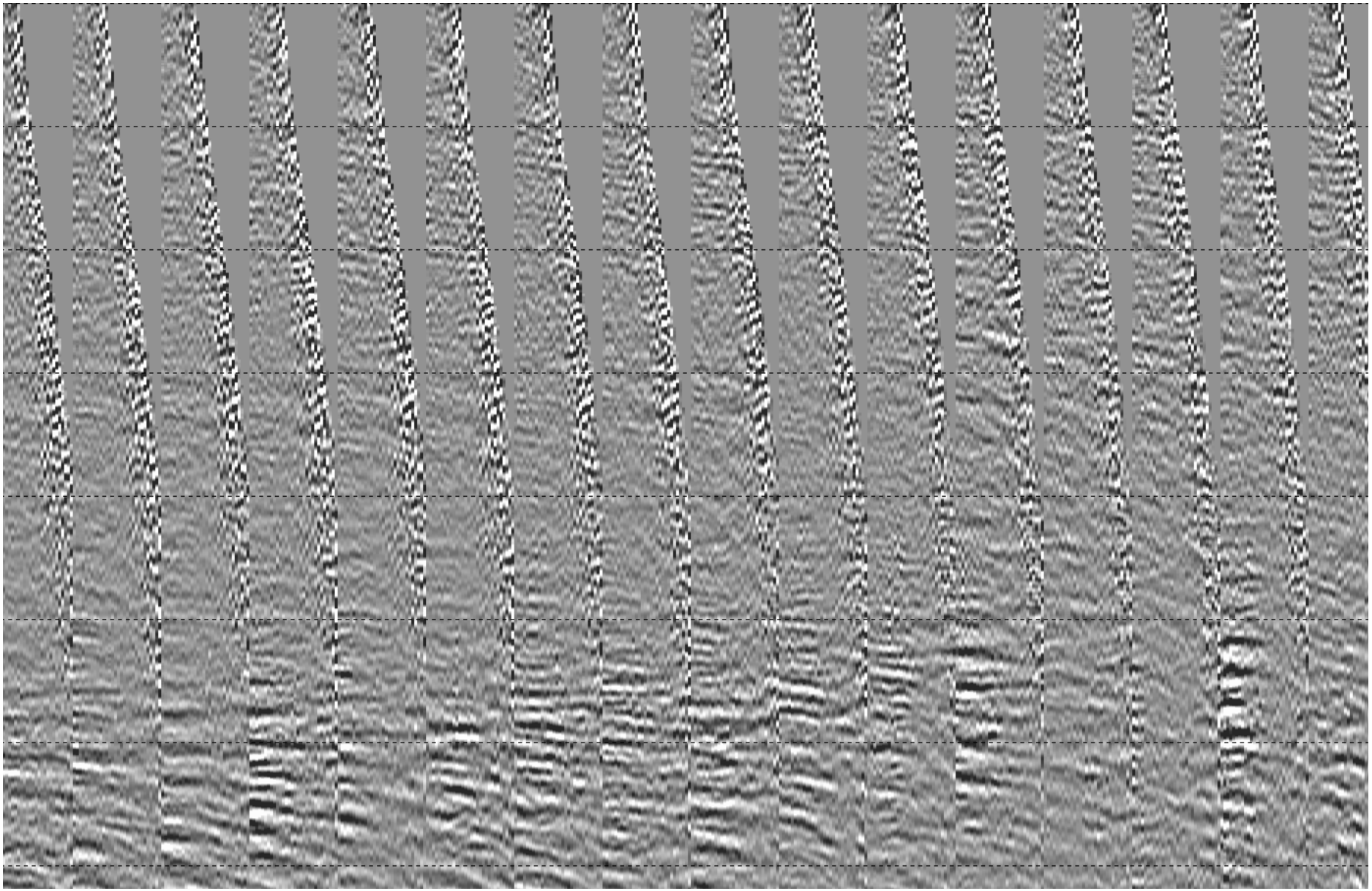
SRME CDPs – before TauP Decon (42ms gap)



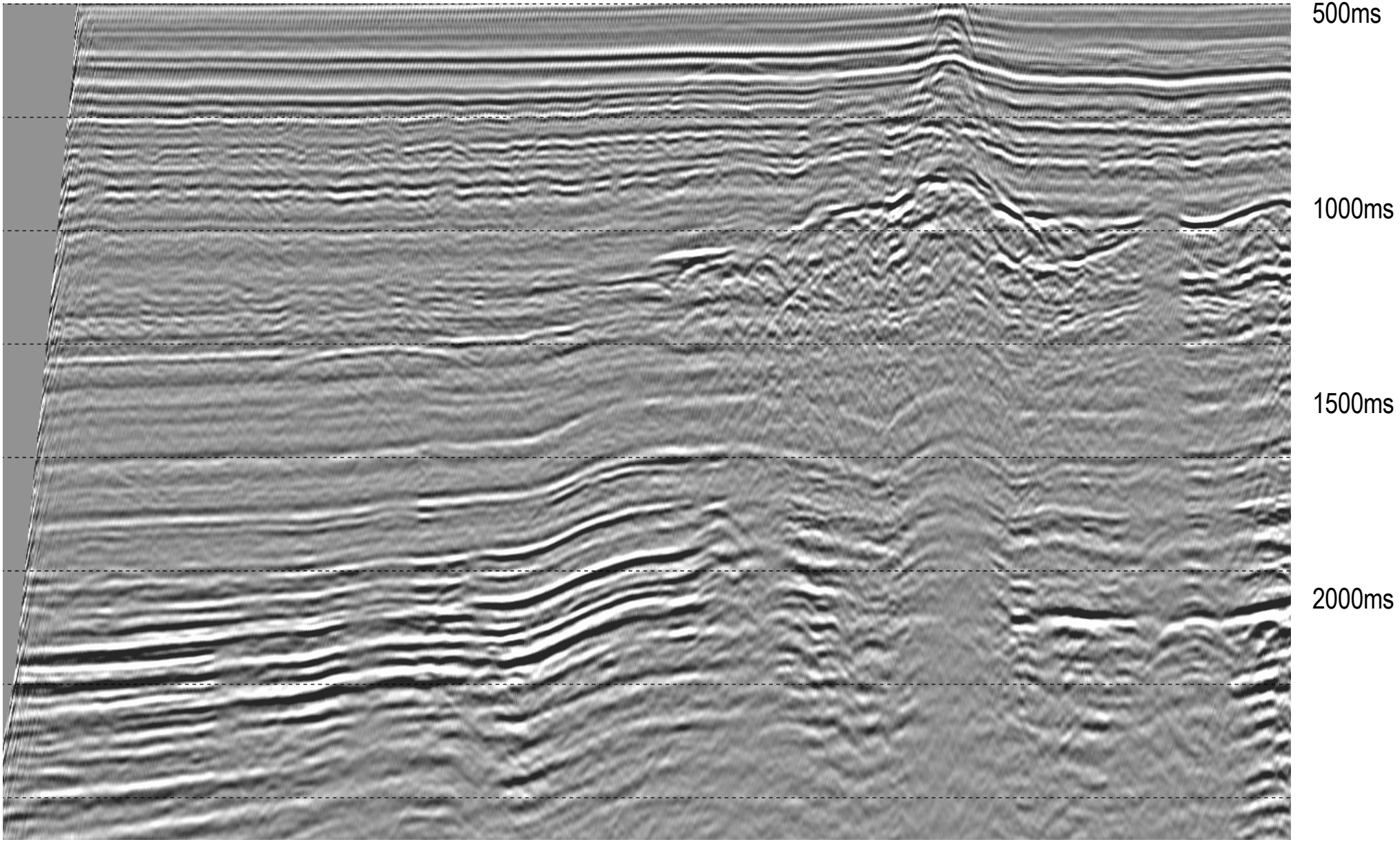
SRME CDPs – after TauP Decon (42ms gap)



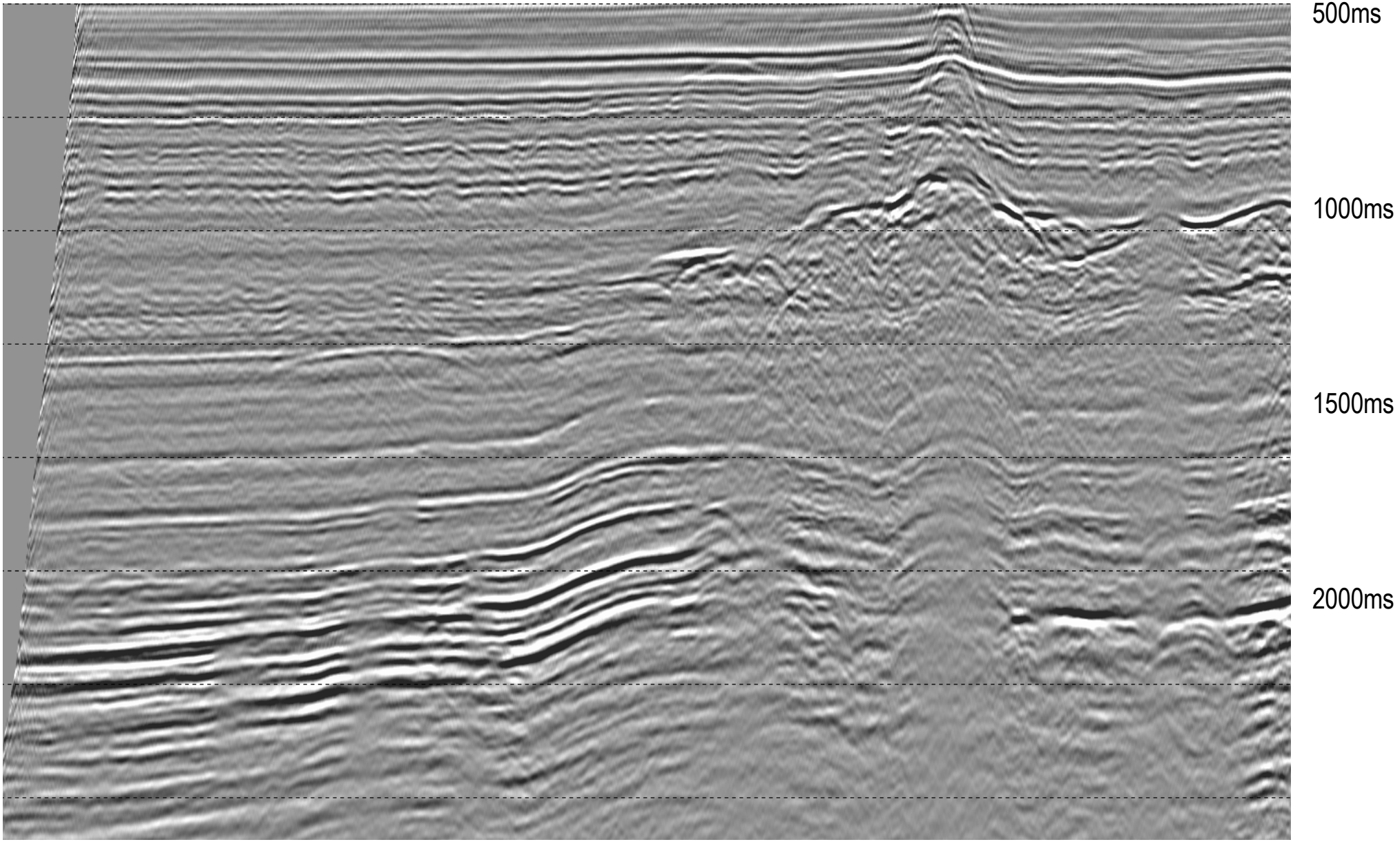
Noise removed by TauP Decon (42ms gap)



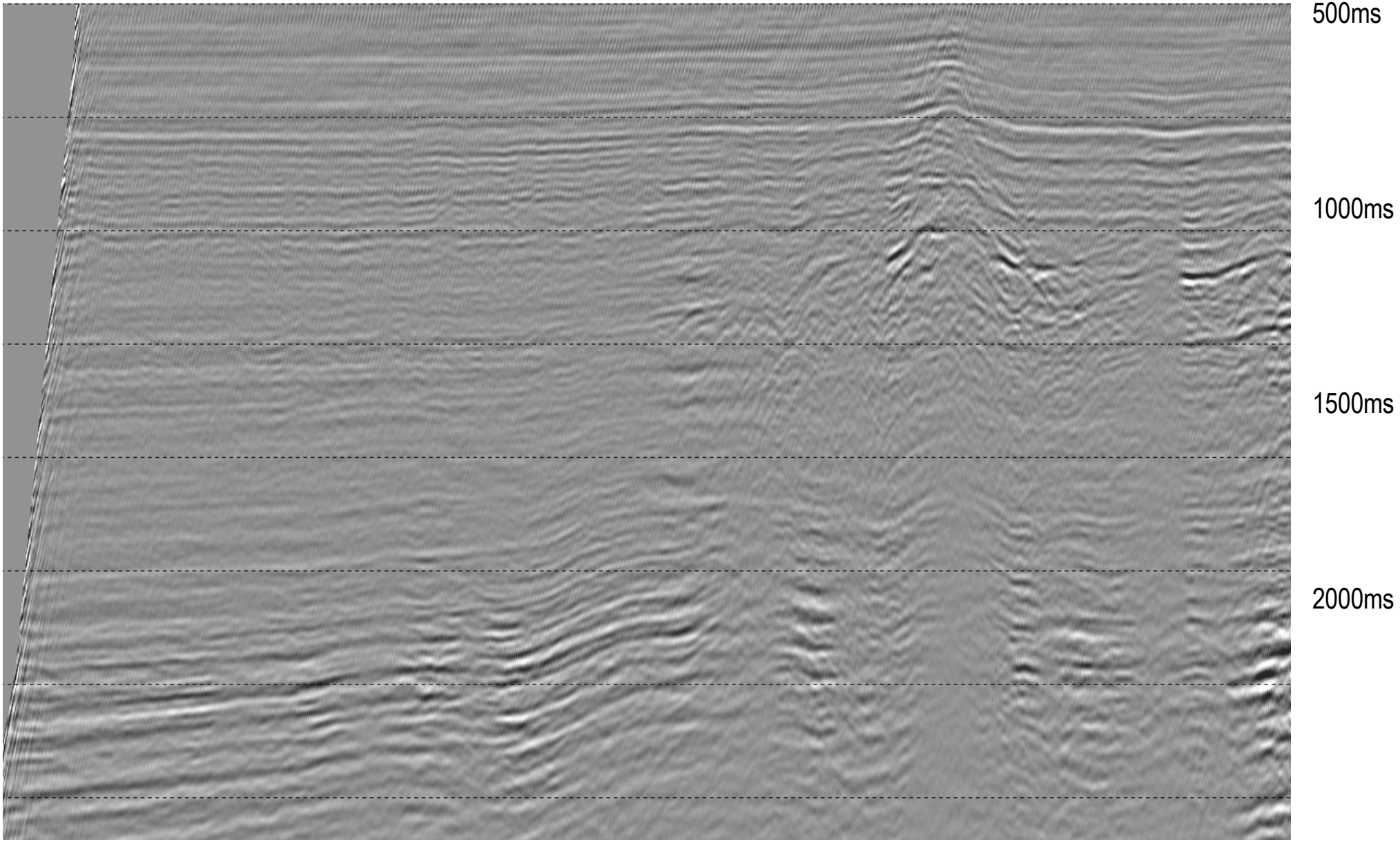
Stack – SRME before TauP Decon



Stack – SRME after TauP Decon (42ms gap)



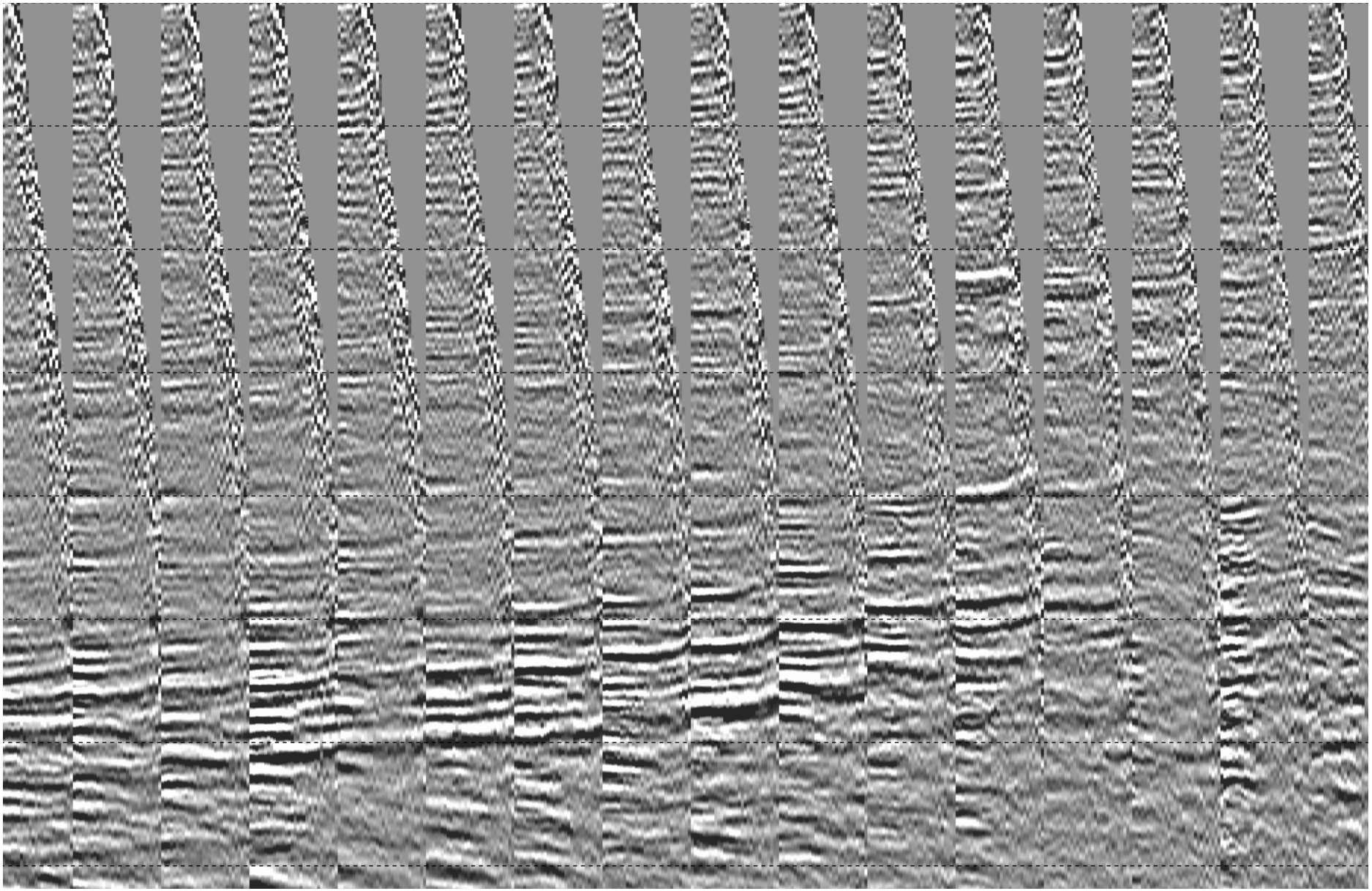
Stack – Noise removed by TauP decon (42ms gap)



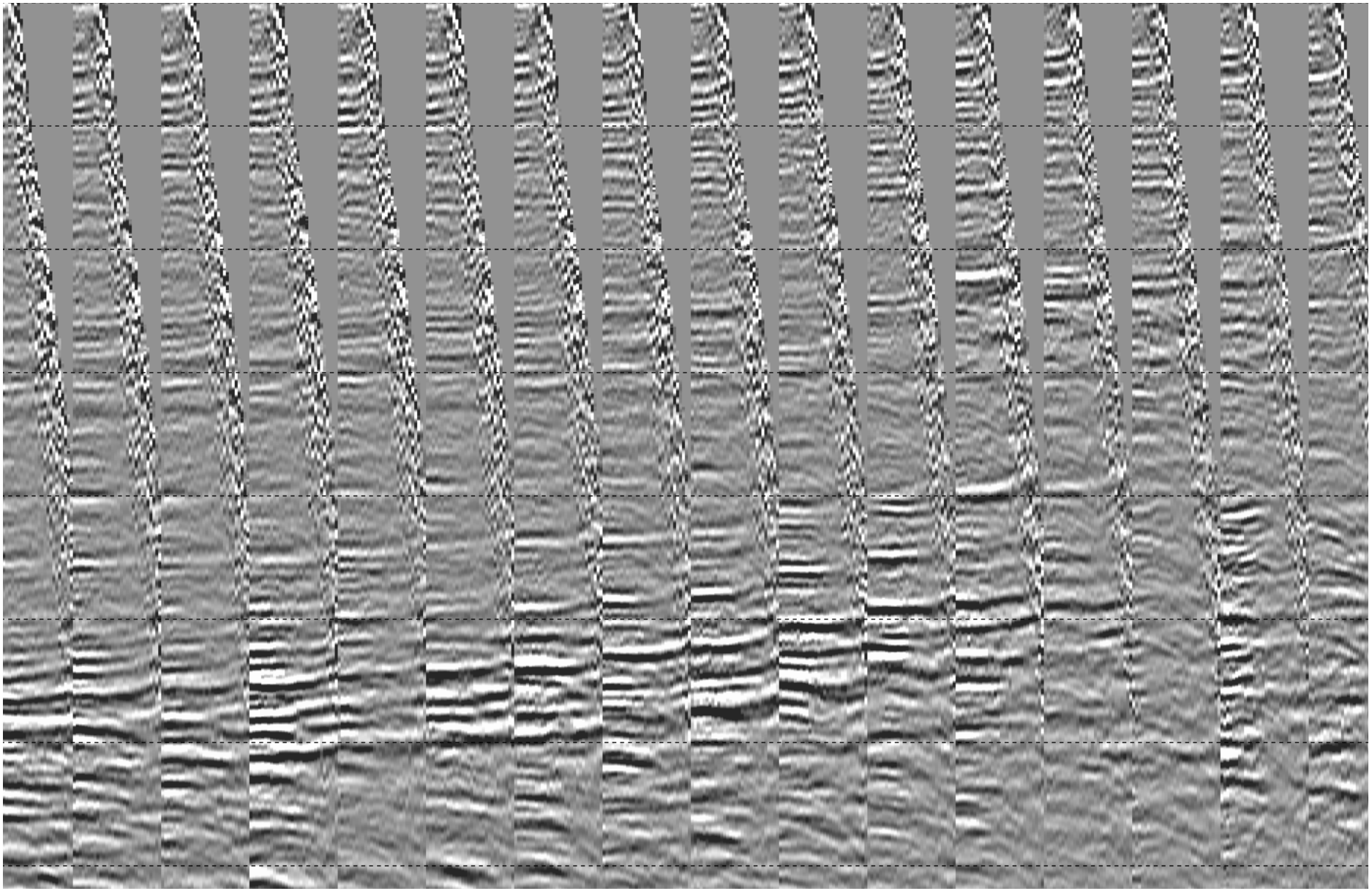
Radon Demultiple (This is preliminary!)

- Initial tests were run for Radon demultiple. (These will be revisited when the velocity field has been repicked.)
- A very mild radon demultiple was used to remove any remnant multiple energy and dipping noise. Shot point interpolation was again used to de-alias the multiple energy.
  - Parameters used for this flow were as follows:
    - Modelled mulitples: -300 to 2500 ms at the far trace
    - Removed multiples: 200 to 2500 ms at the far trace
    - Offset of far trace: 3100m
    - Hyperbolic basis functions were employed

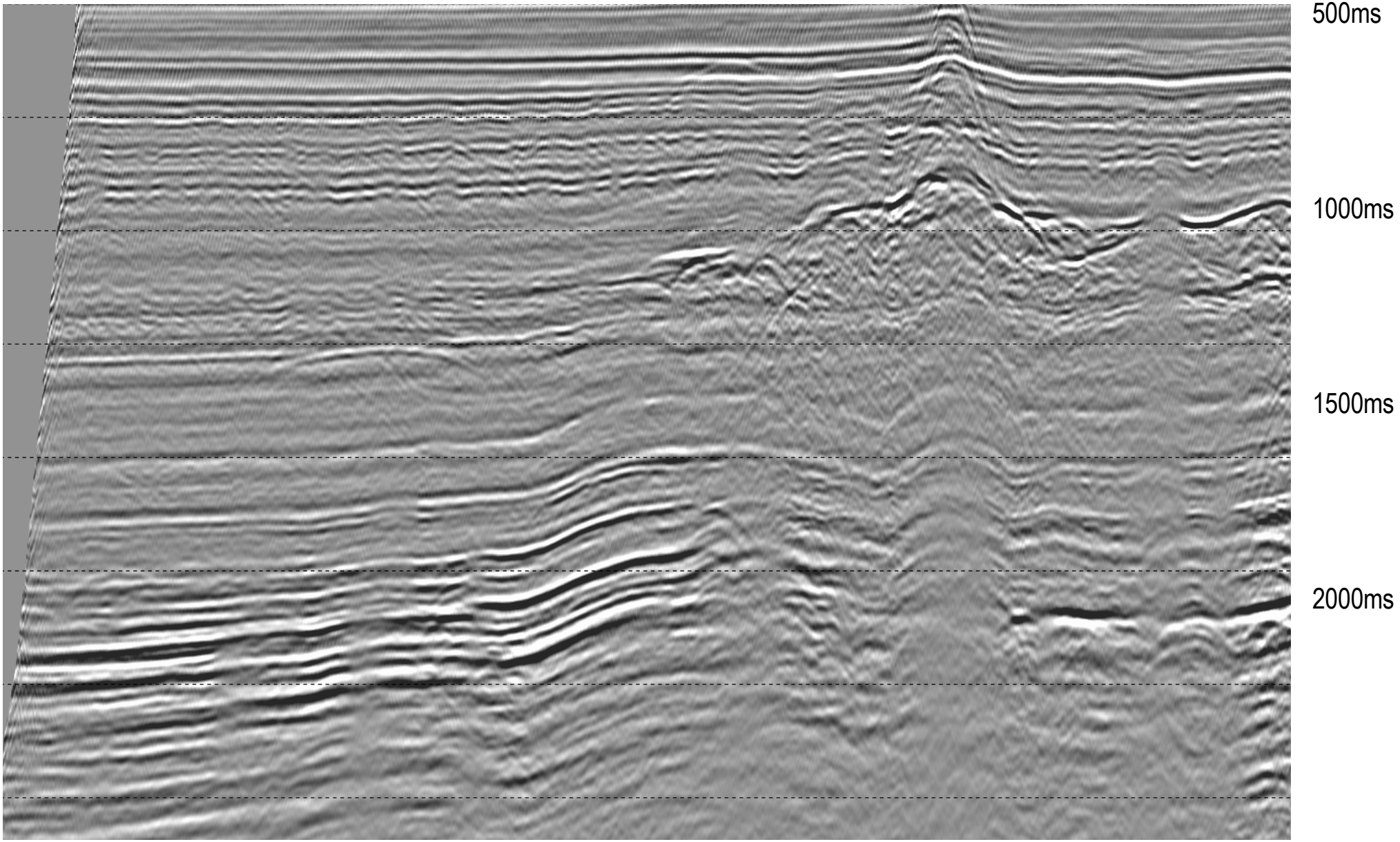
CDPs – before Radon



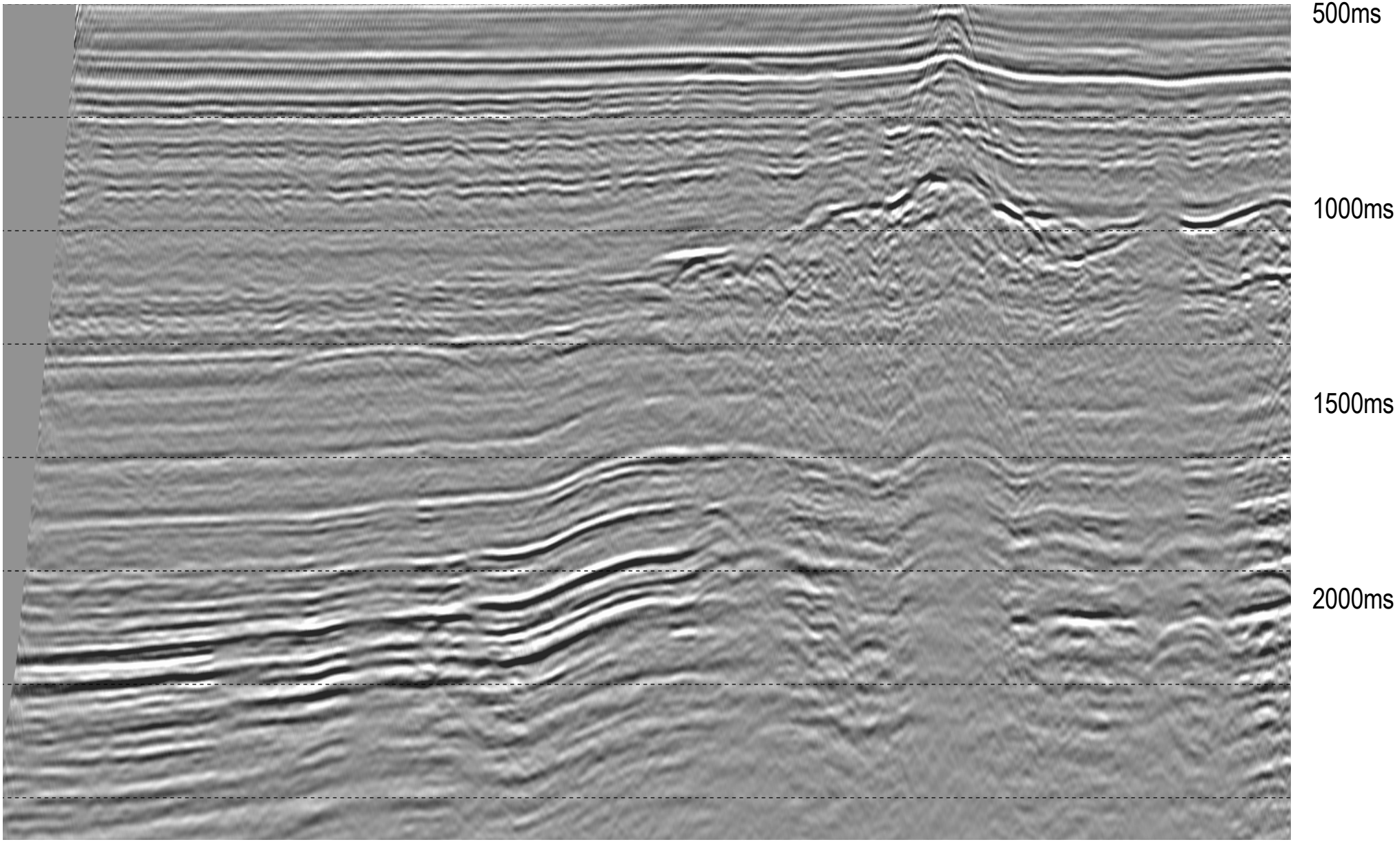
CDPs – after Radon



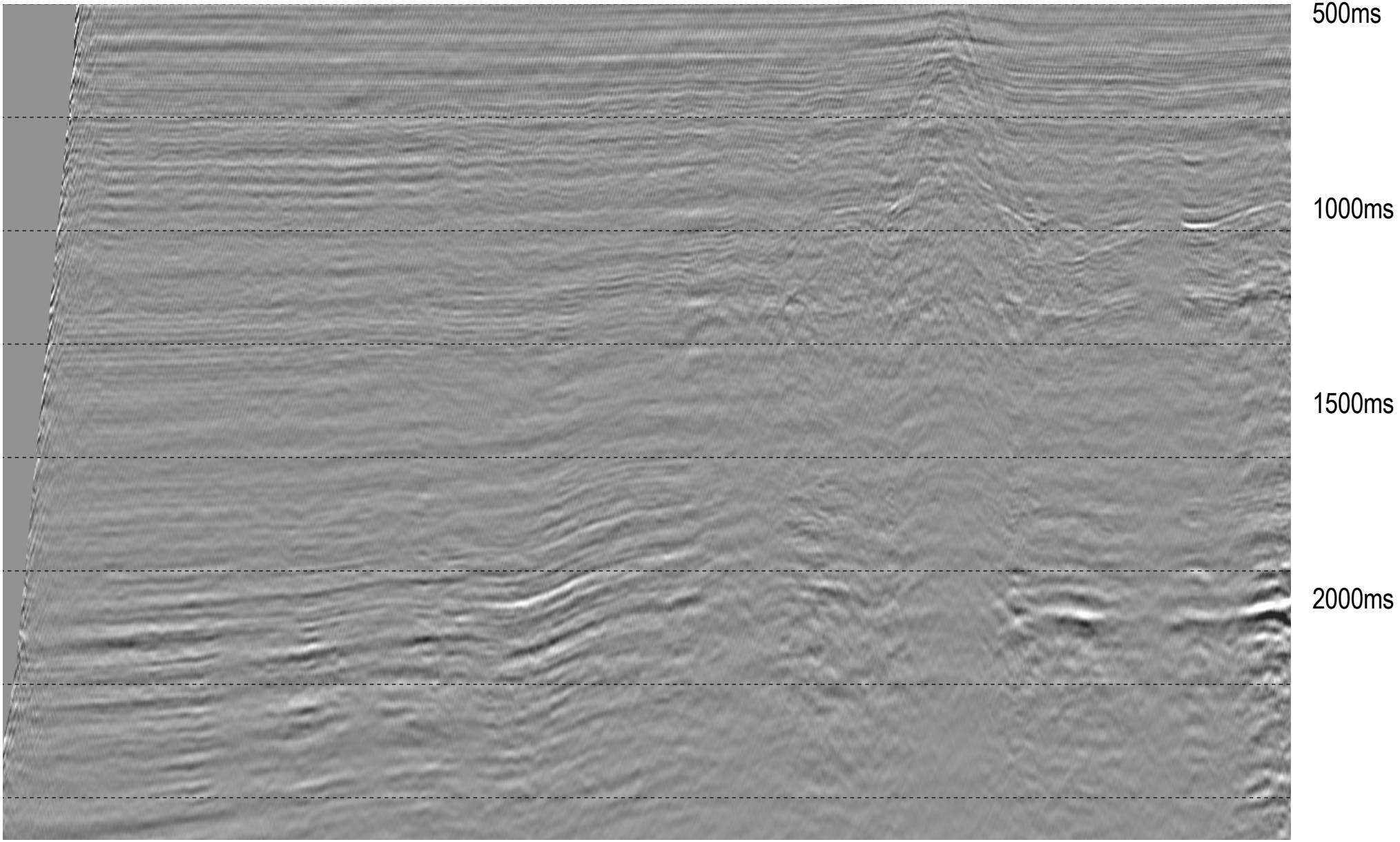
Stack – before Radon



Stack – after Radon



Stack – Noise removed by Radon demultiple



DownUnder GeoSolutions

Designature tests

1st July 2009

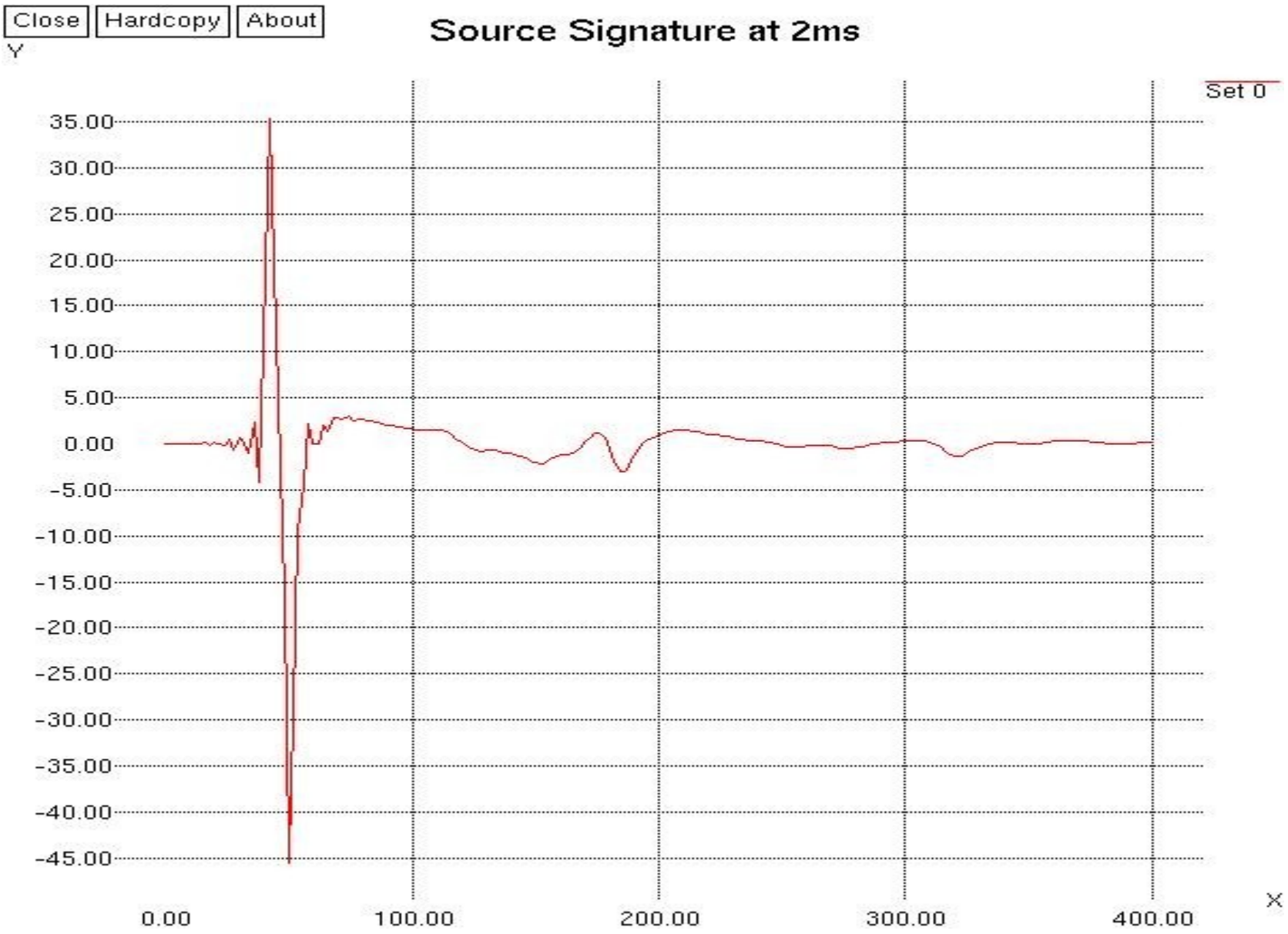
Origin Energy Resources Ltd

Yolla 3D Marine Seismic Survey Reprocessing

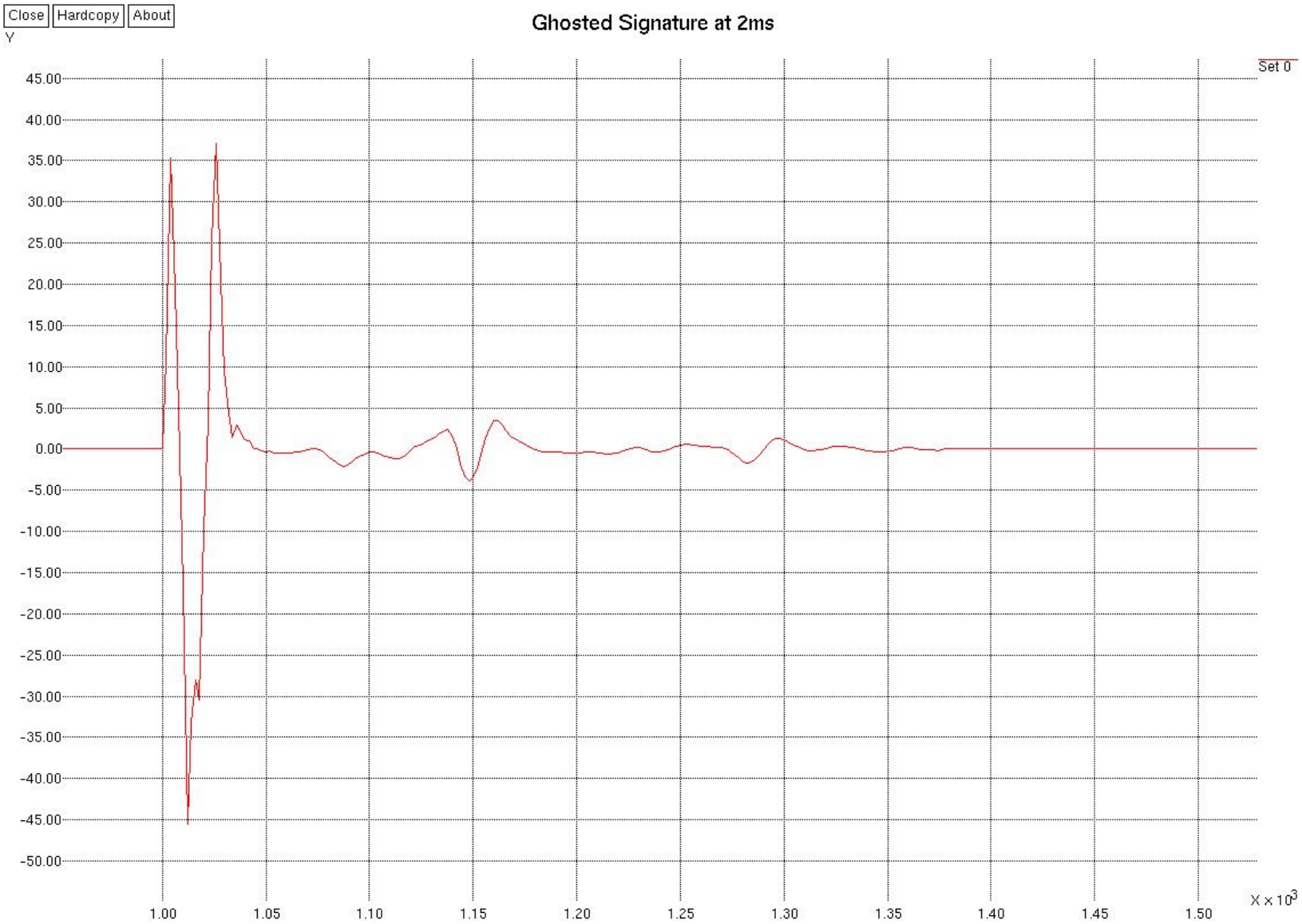
Summary

- A source signature was modelled using the source information in the supplied acquisition reports.
- A filter was then derived to convert this signature to it's zero phase equivalent.
- This report shows the result of applying this filter to the modelled signature and to the data.

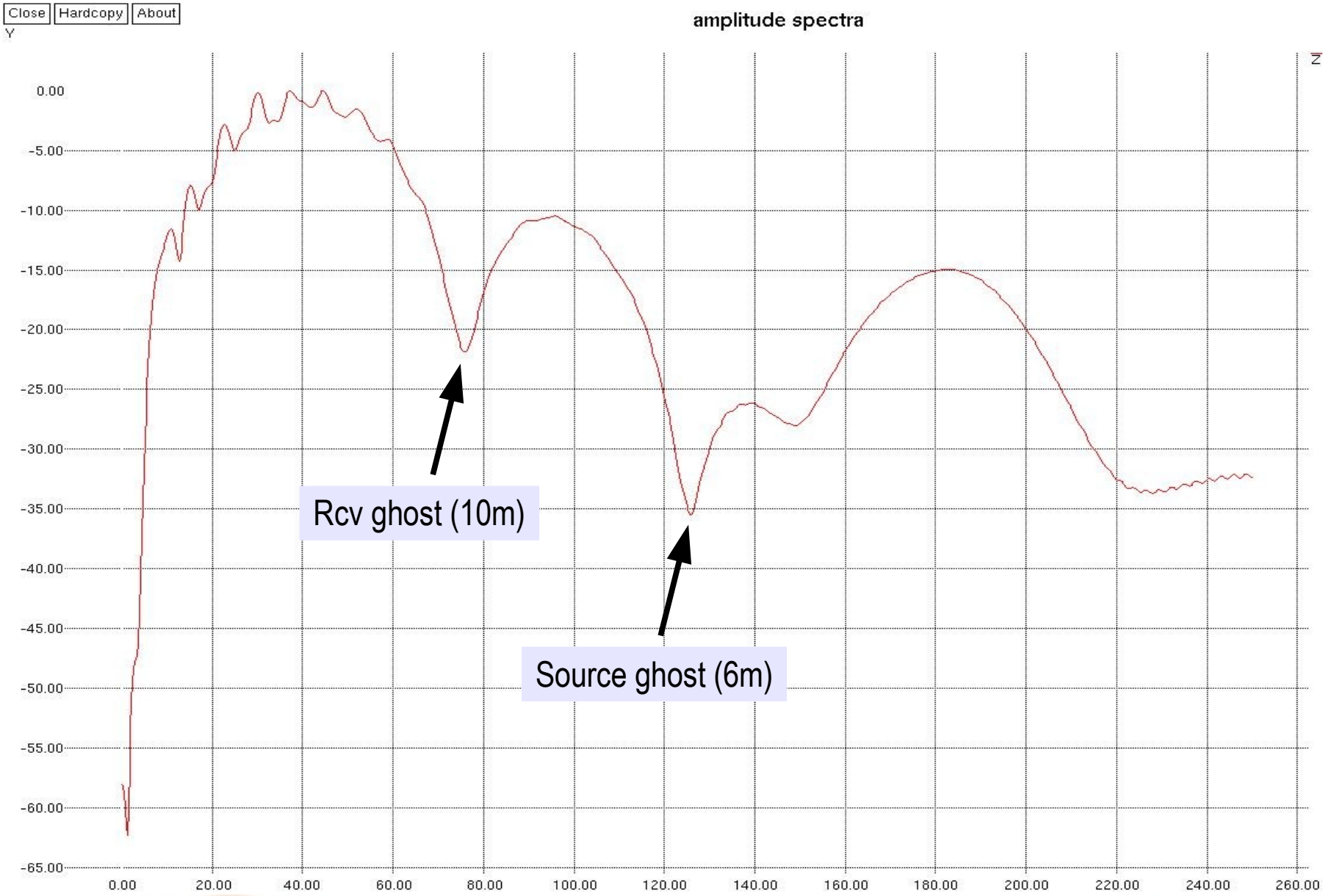
Modelled source signature without receiver ghost



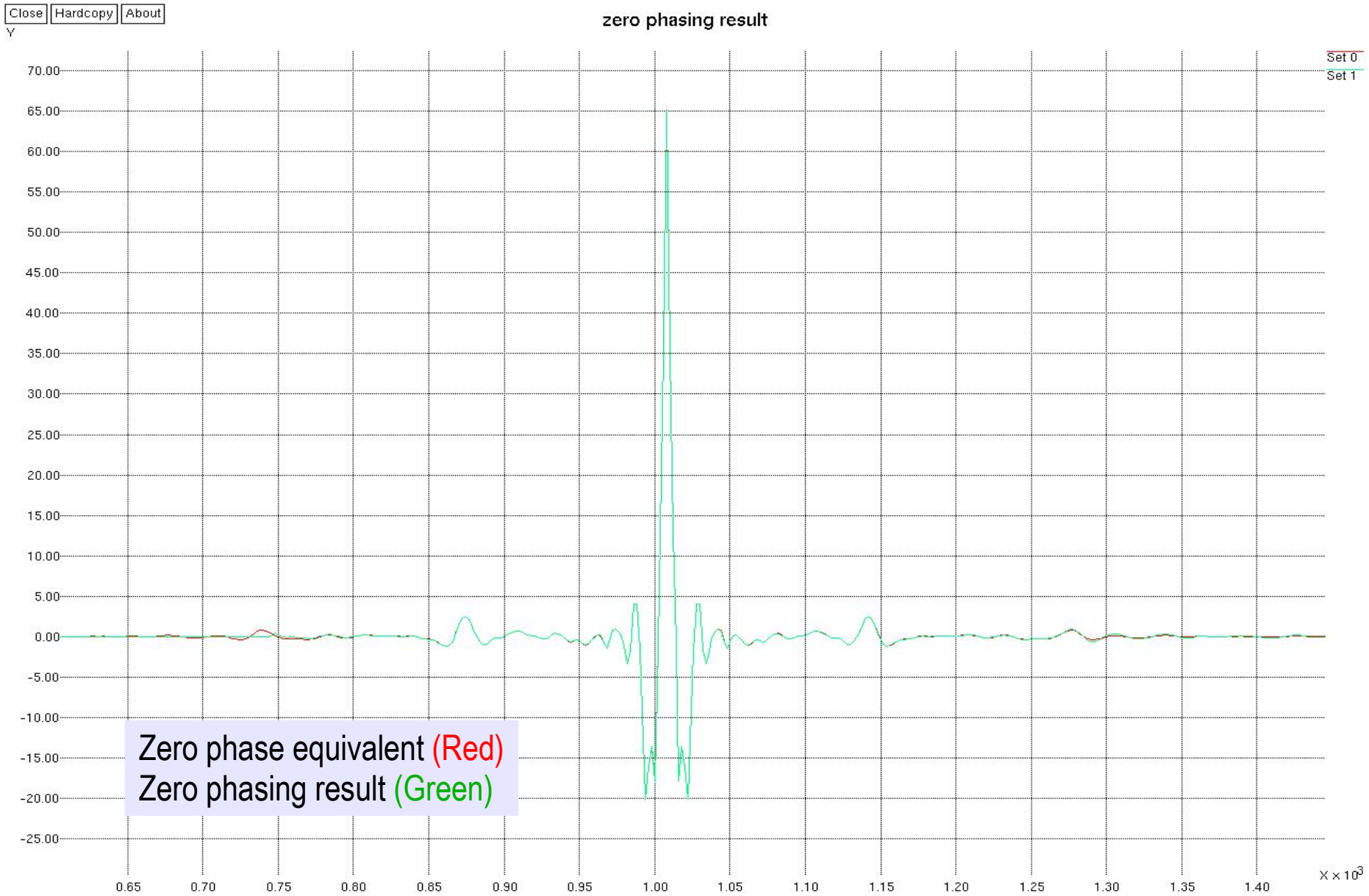
Modelled source signature with receiver ghost



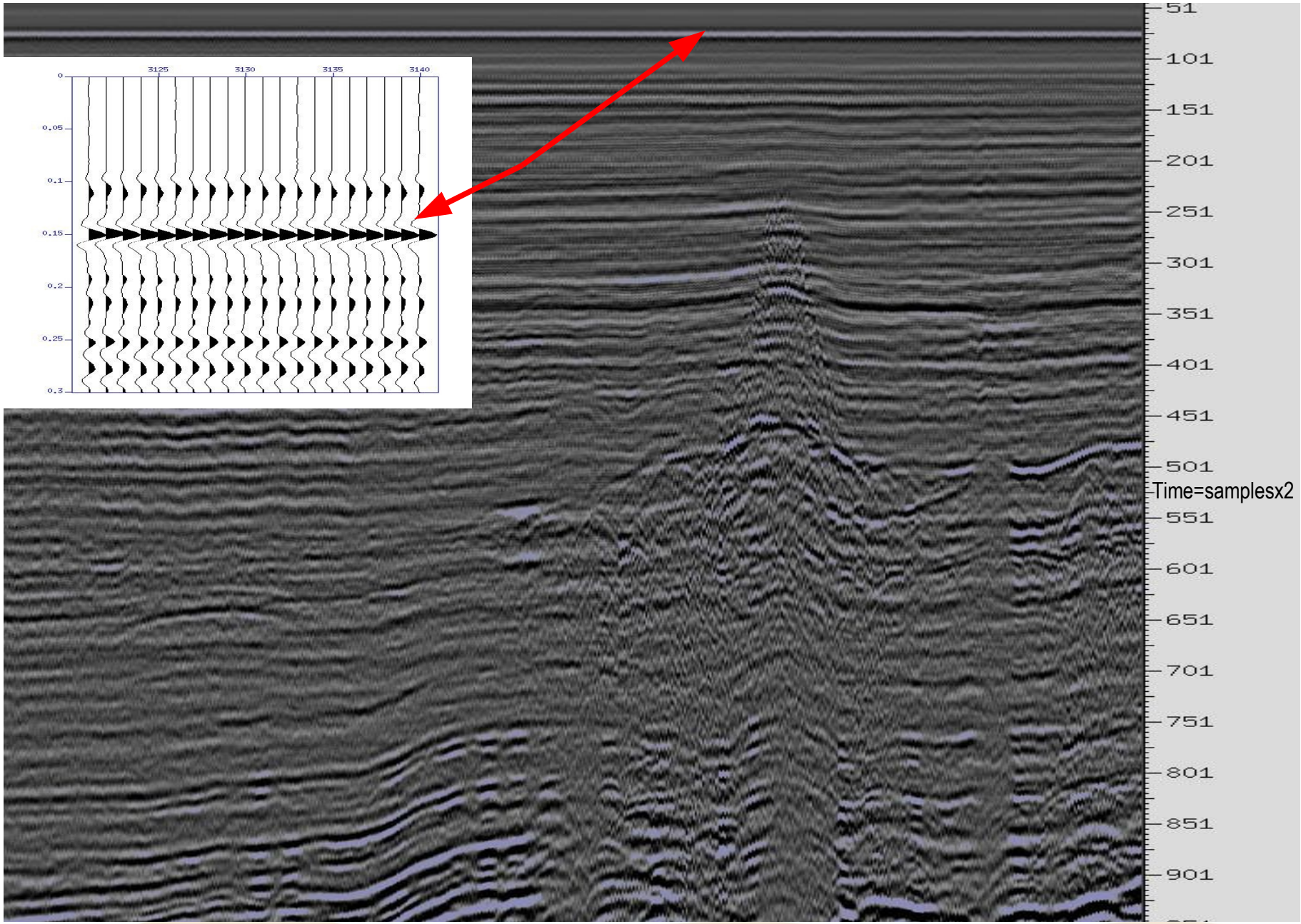
Amplitude spectrum of modelled signature



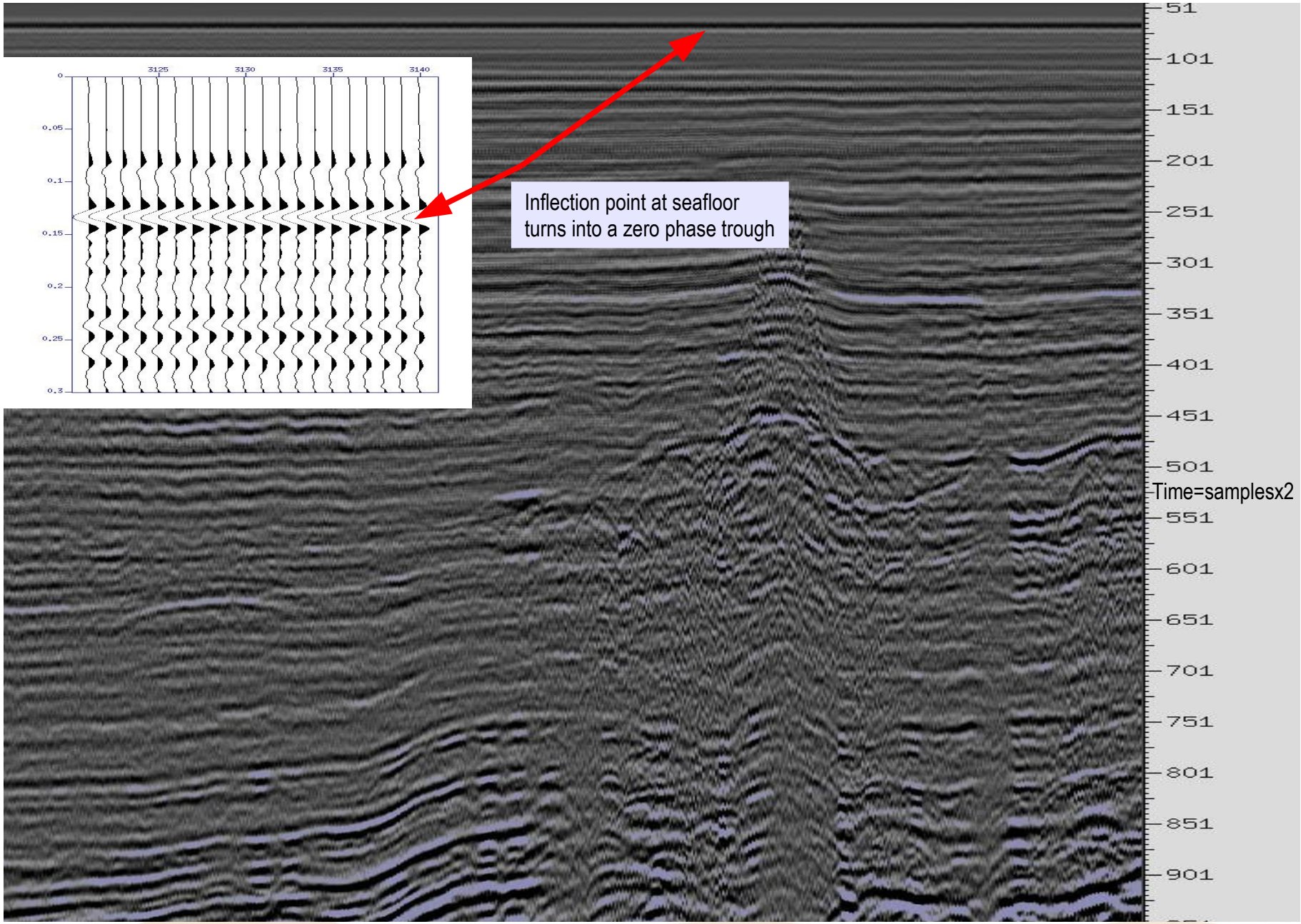
Result of zero-phasing



Near trace before zero-phasing

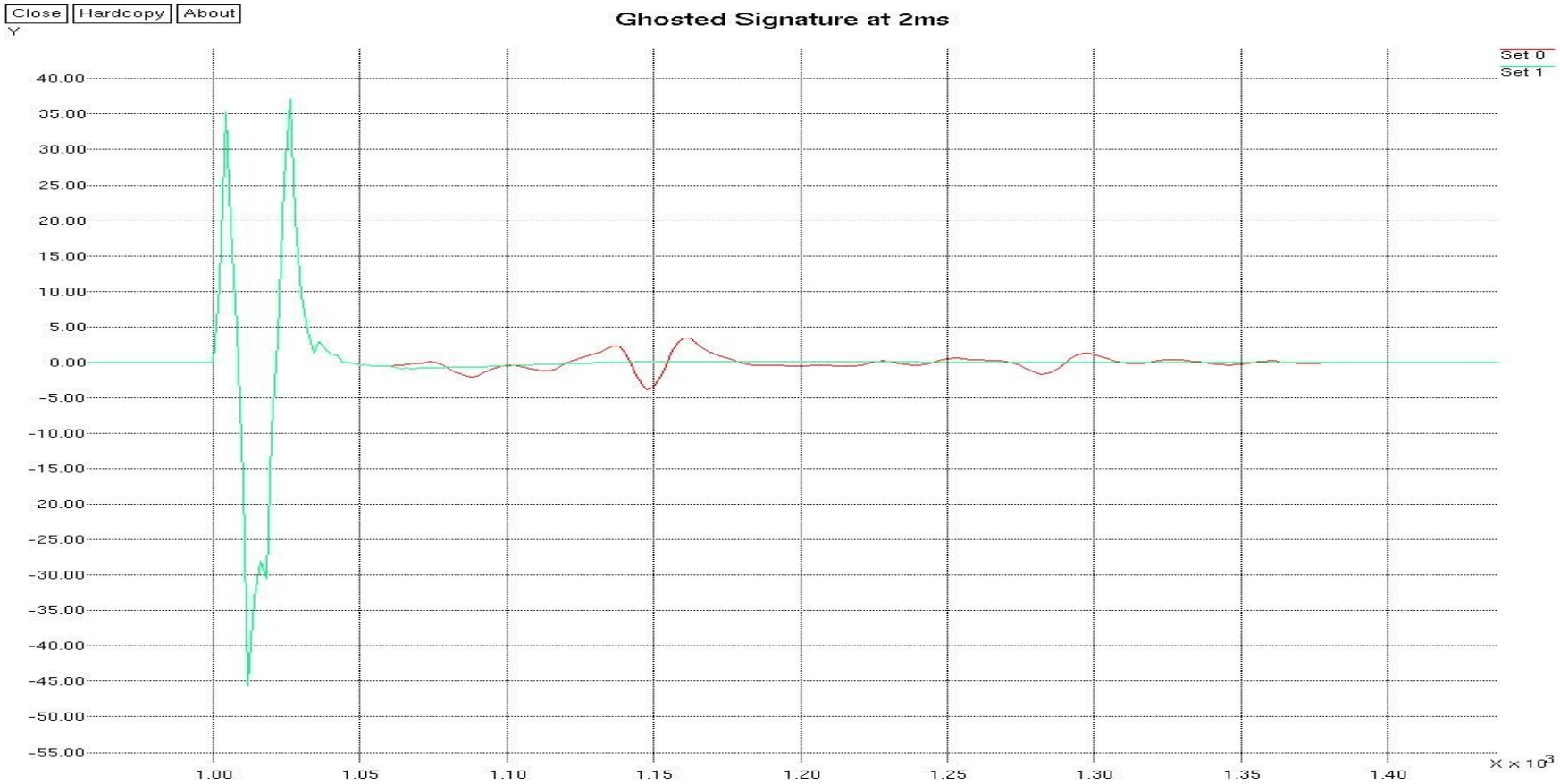


Near trace after zero-phasing



Debubbling option

Randall – this is what I meant with debubbling (The green signature is the result of a long gap deconvolution applied to the signature. The zero phase equivalent of this signature can be used as the target wavelet)



DownUnder GeoSolutions

Velocity Picking Report

3rd August 2009

Origin Energy Resources Ltd

Yolla 3D Marine Seismic Survey Reprocessing

Velocity Report:

- This report outlines the method of radon velocity field picking, using the DUG velocity picker. Both stack and semblance picking methodologies are shown.

Picking velocities: Stacks

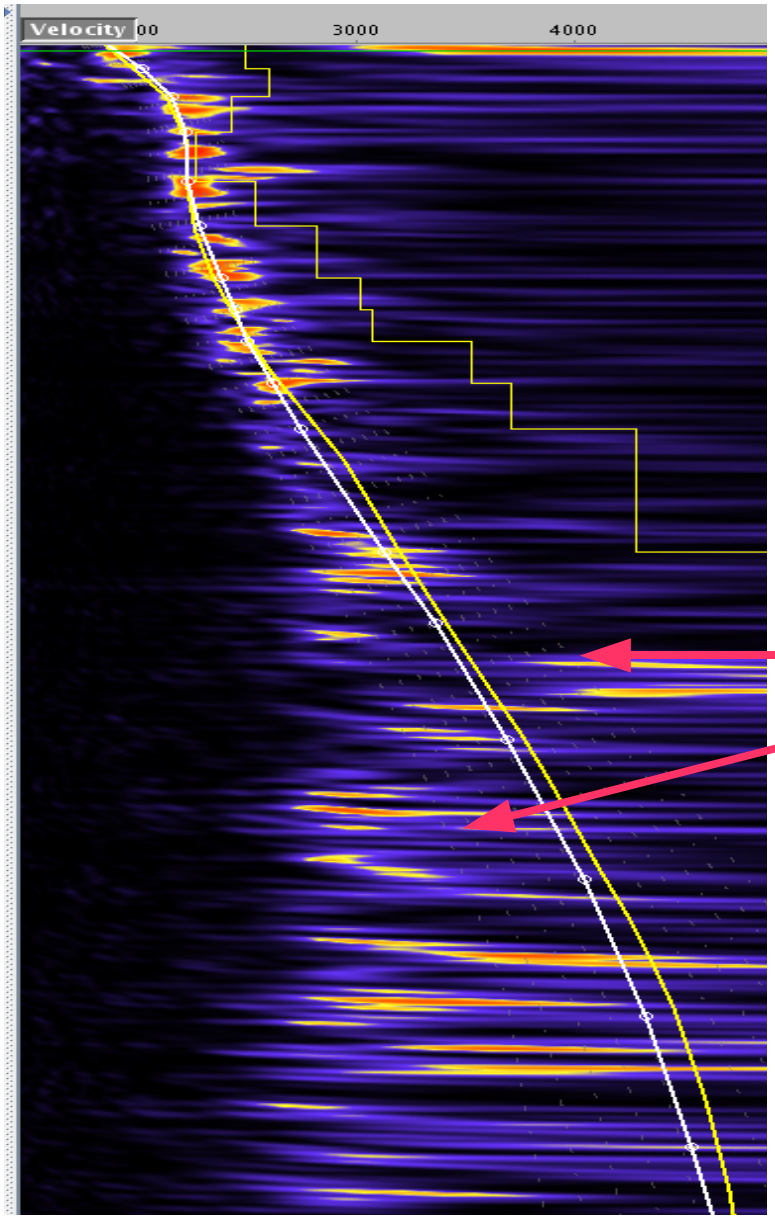
The DUG velocity picking program uses stacks generated with velocity variations to create movies. This is done by choosing a central function (in this case the supplied velocities) and applying percentage variations to generate a number of velocity functions or fans. The data is then stacked using these fans to create a series of images that vary only in the velocity used for normal move out.

For this project the velocity variation between images is 0.6% at 0s, 1.3% at 1s, 3.0% at 5s, and 3.3% at 6s and 11 images were generated.

Picks on the stack are colour coded for quality control purposes. Picks slower than the velocity used to create the stack are yellow, picks faster than the velocity used to create the stack are purple and picks close to the current stack's velocity are green.

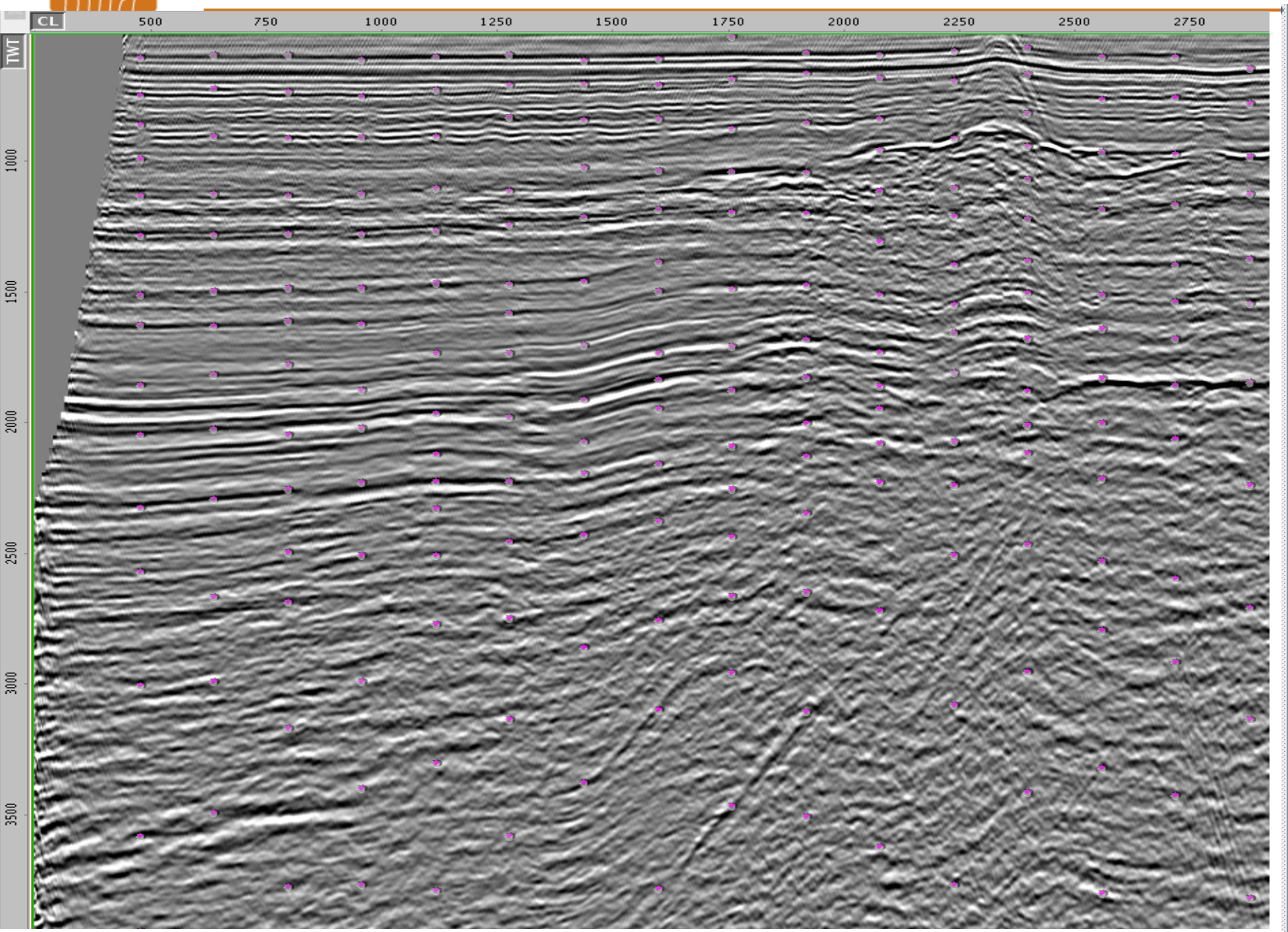
Below are the 7 central stacks in ascending order of velocity for both testlines.

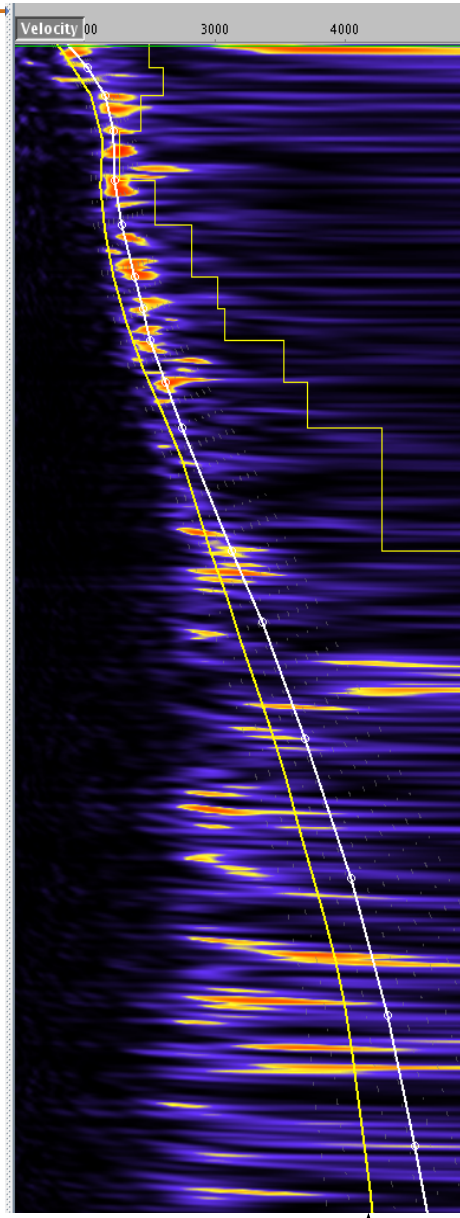
Velocity fans



Stacks are built using these velocity profiles which vary by constant amounts from the central function

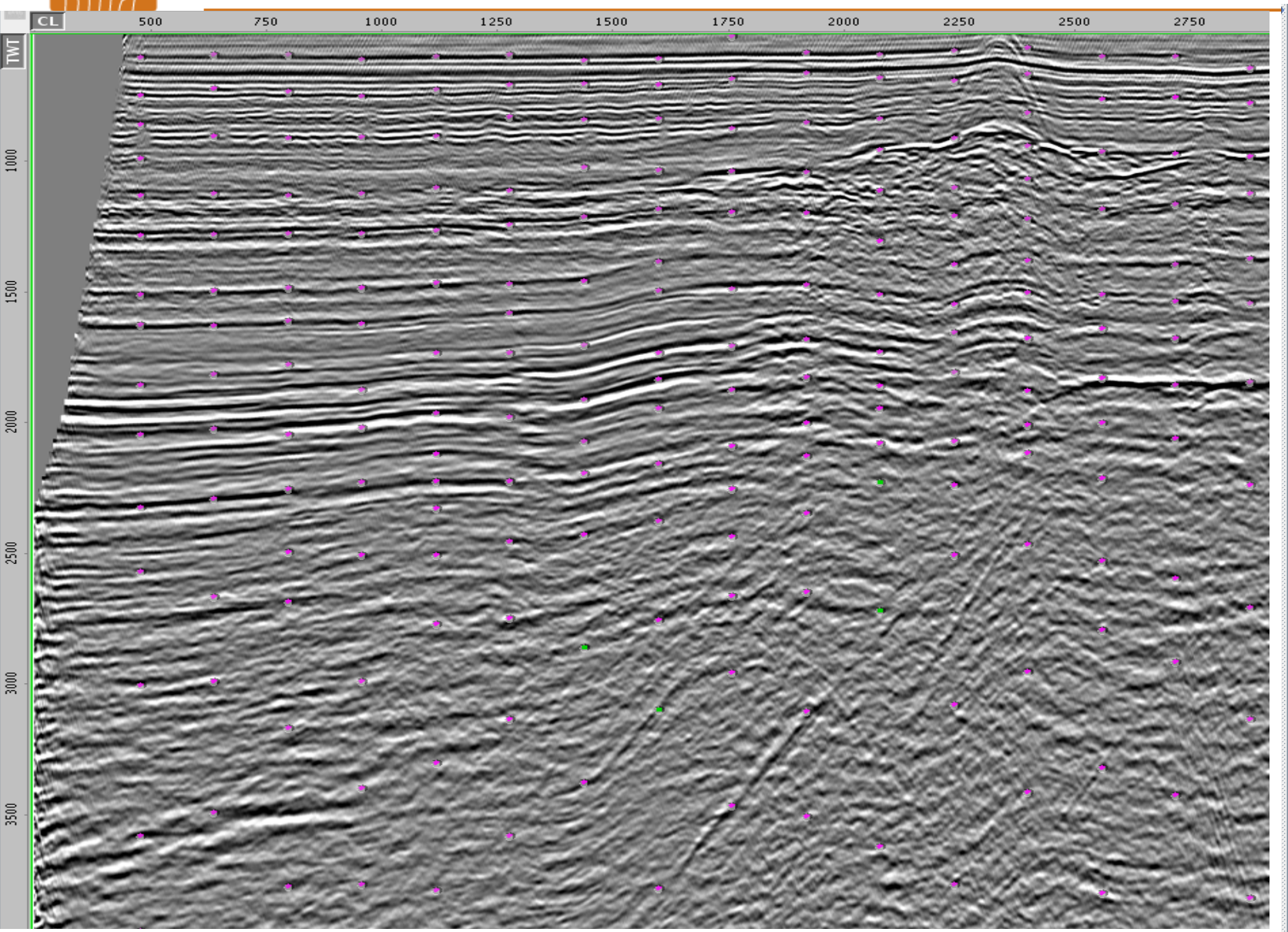
YOL00493: Stack 1

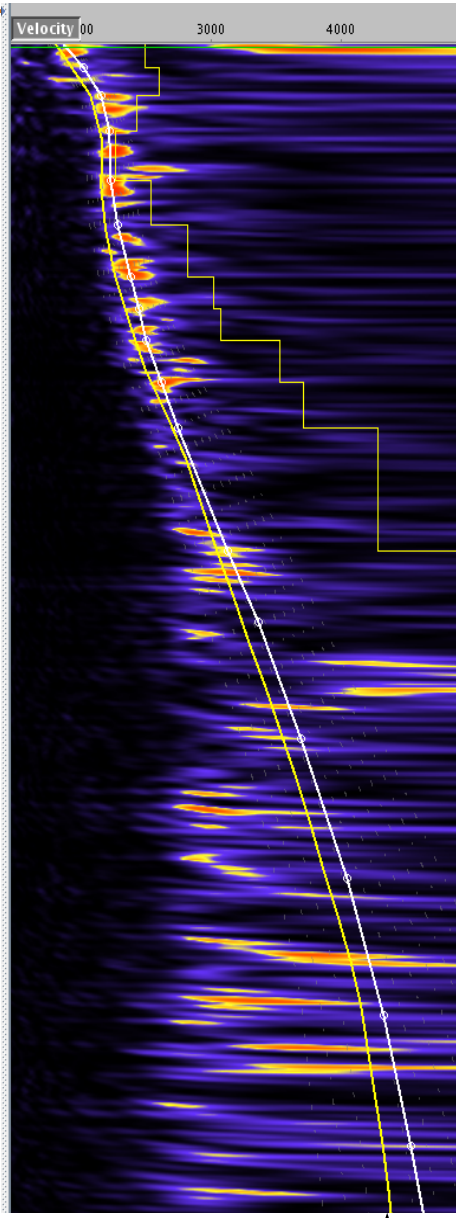




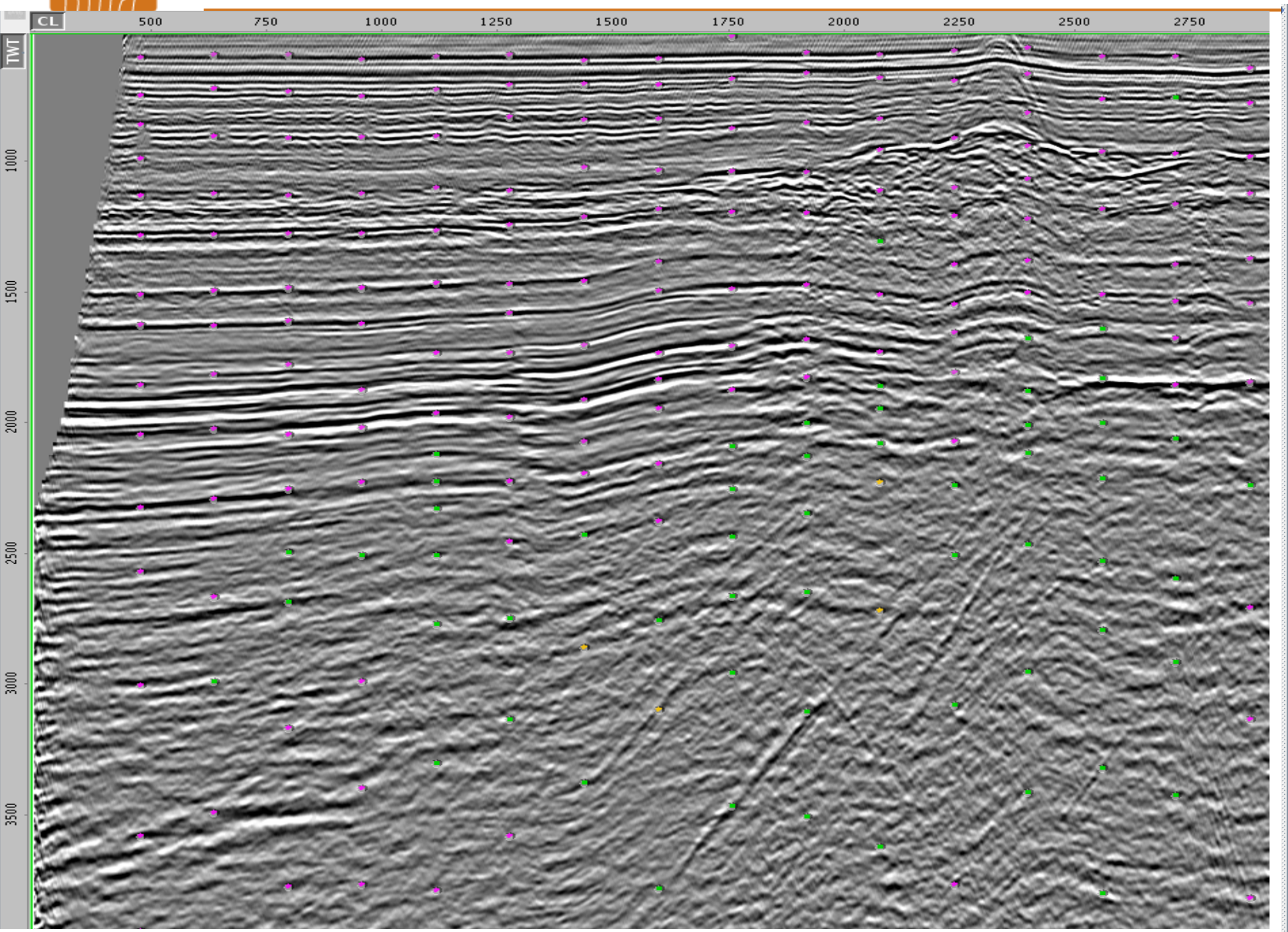
Velocity function used to generate the stack

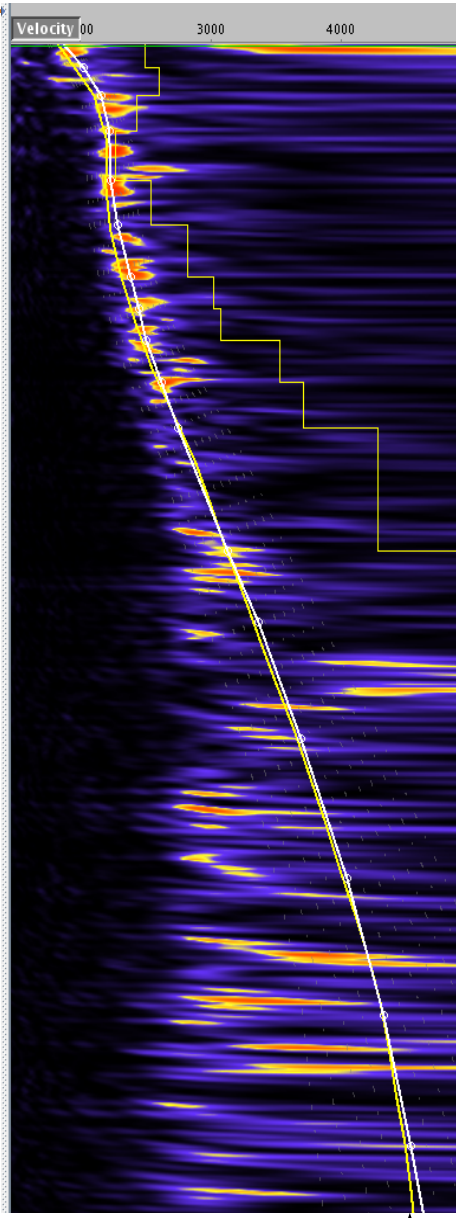
YOL00493: Stack 2



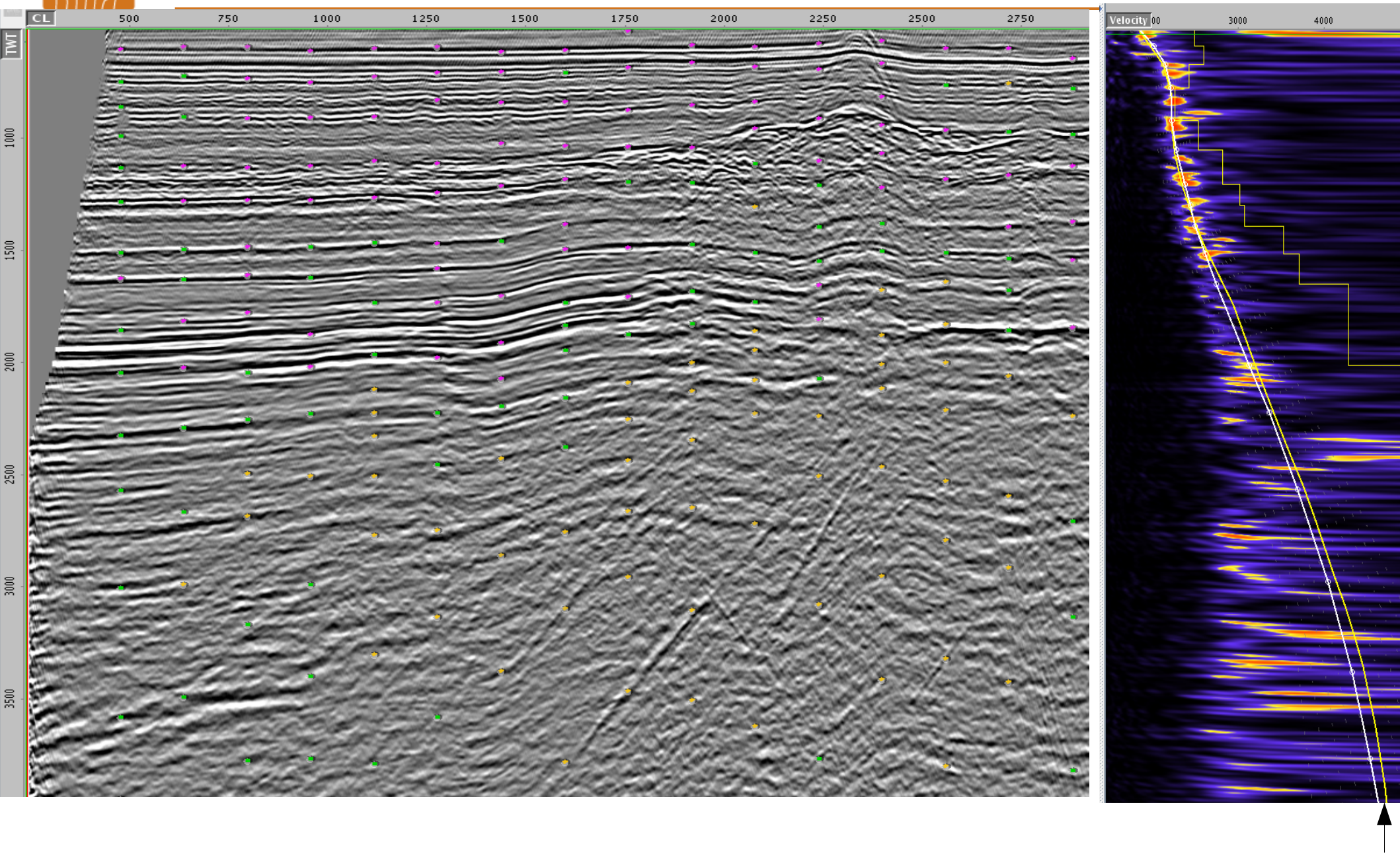


YOL00493: Stack 3

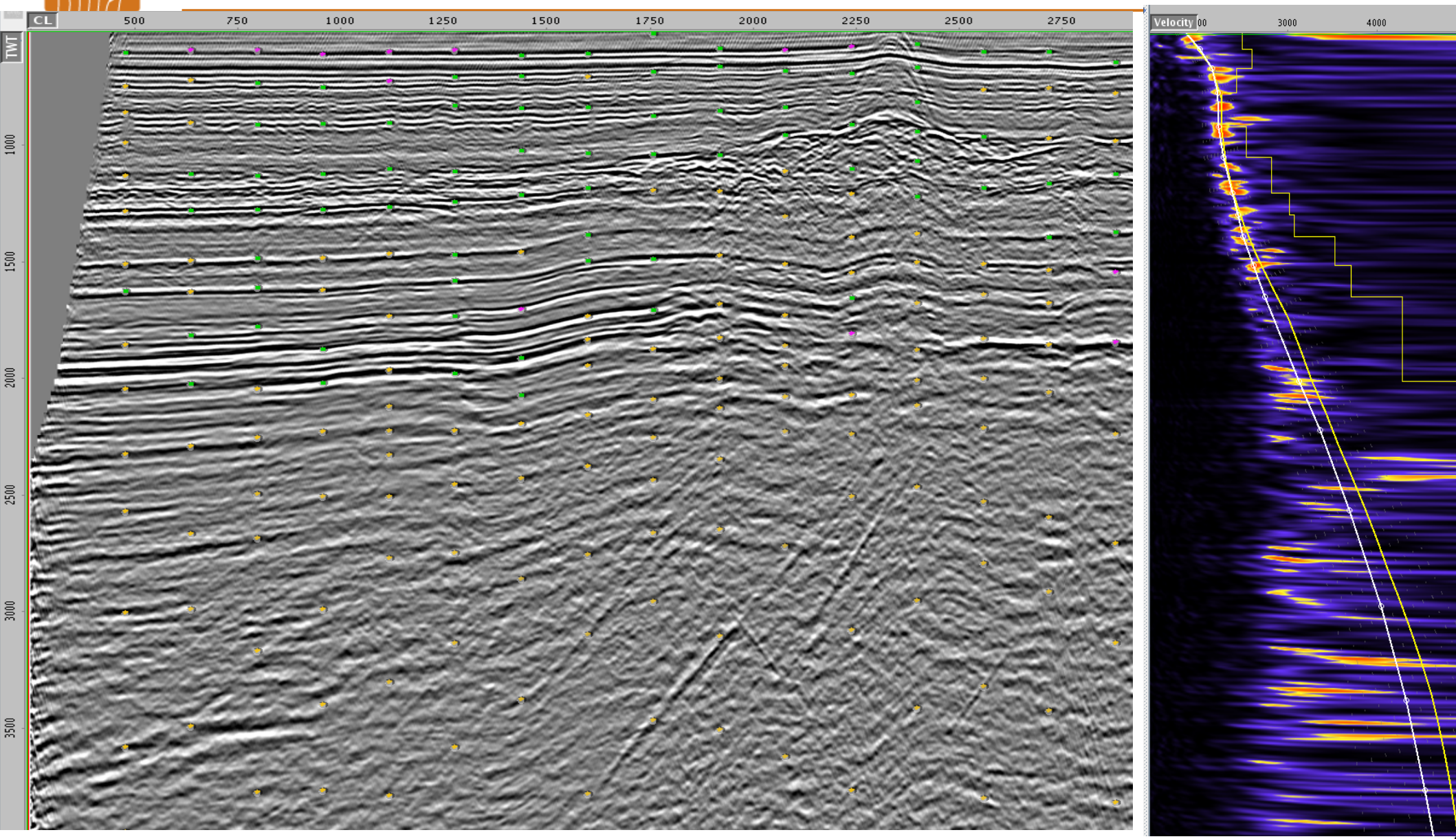




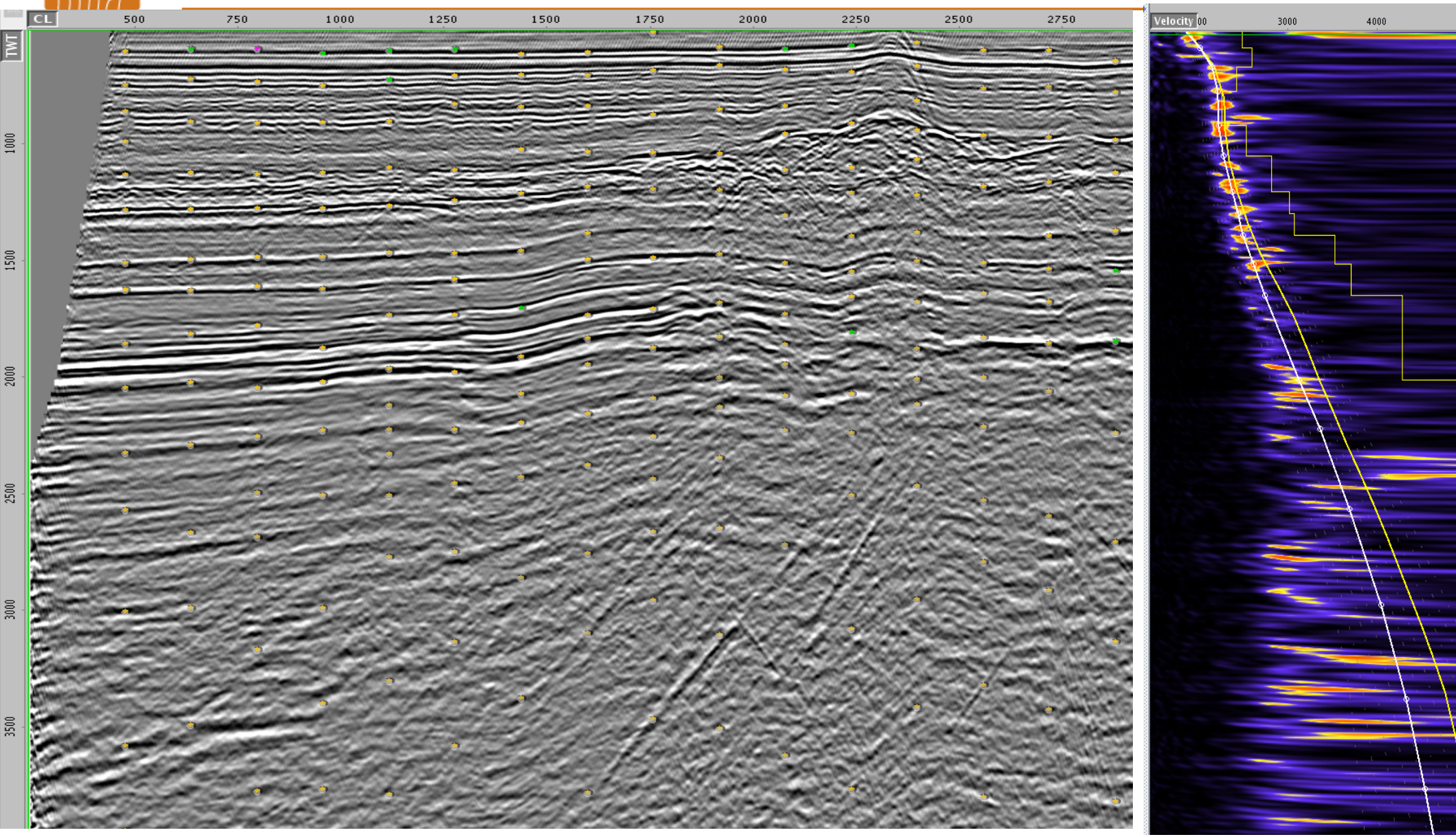
YOL00493: Stack 4 (Central Velocity Function)



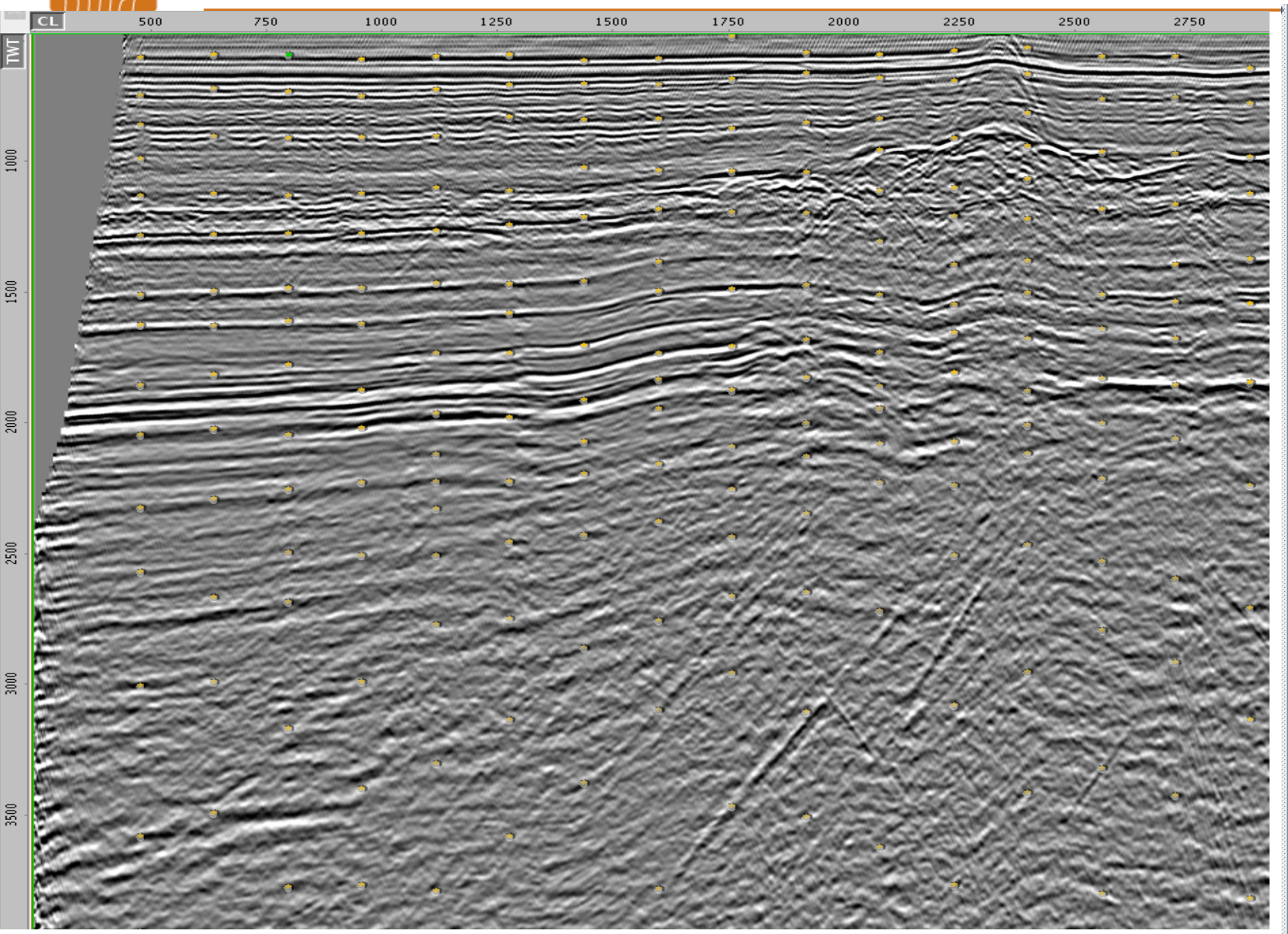
YOL00493: Stack 5

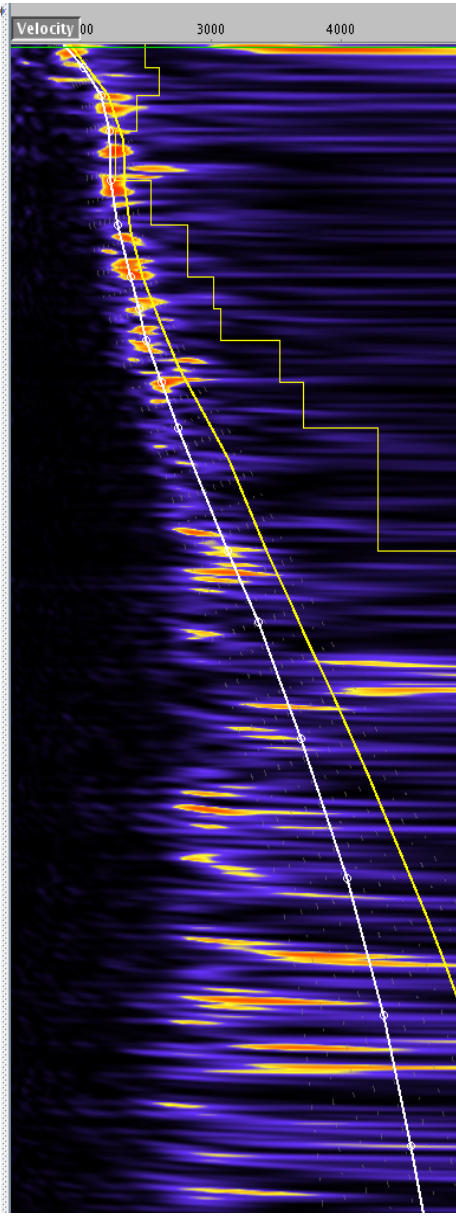


YOL00493: Stack 6

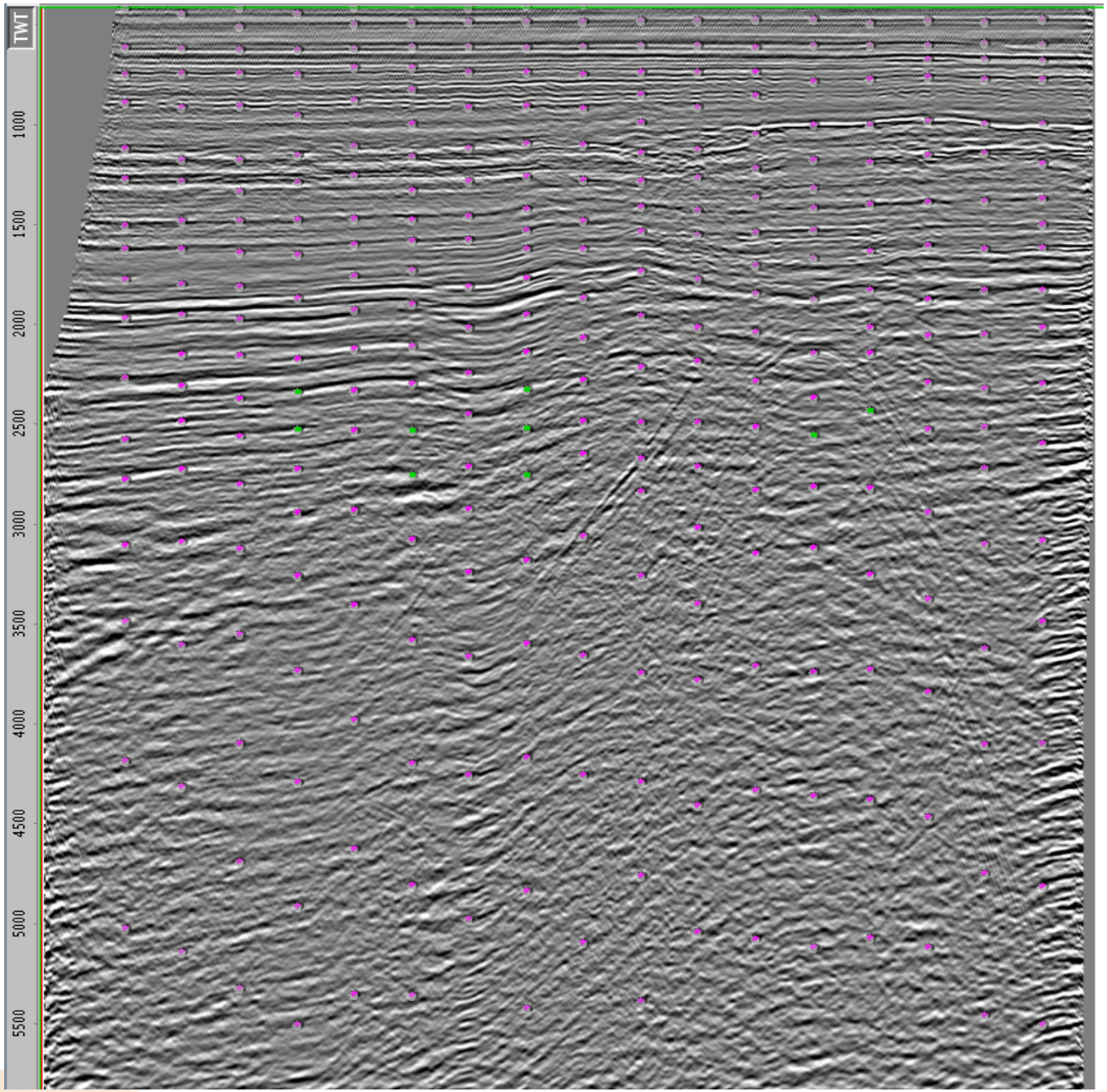


YOL00493: Stack 7

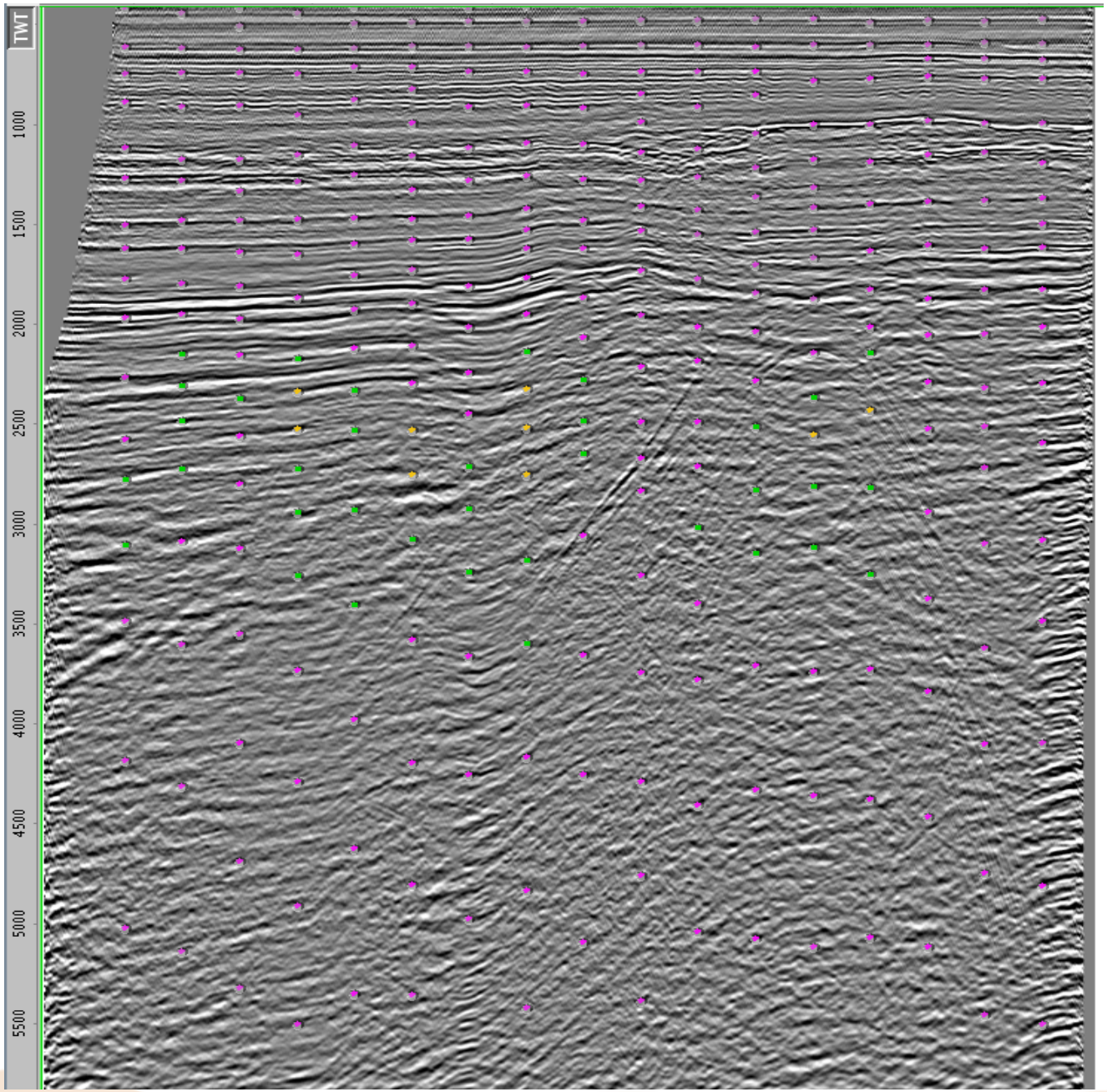




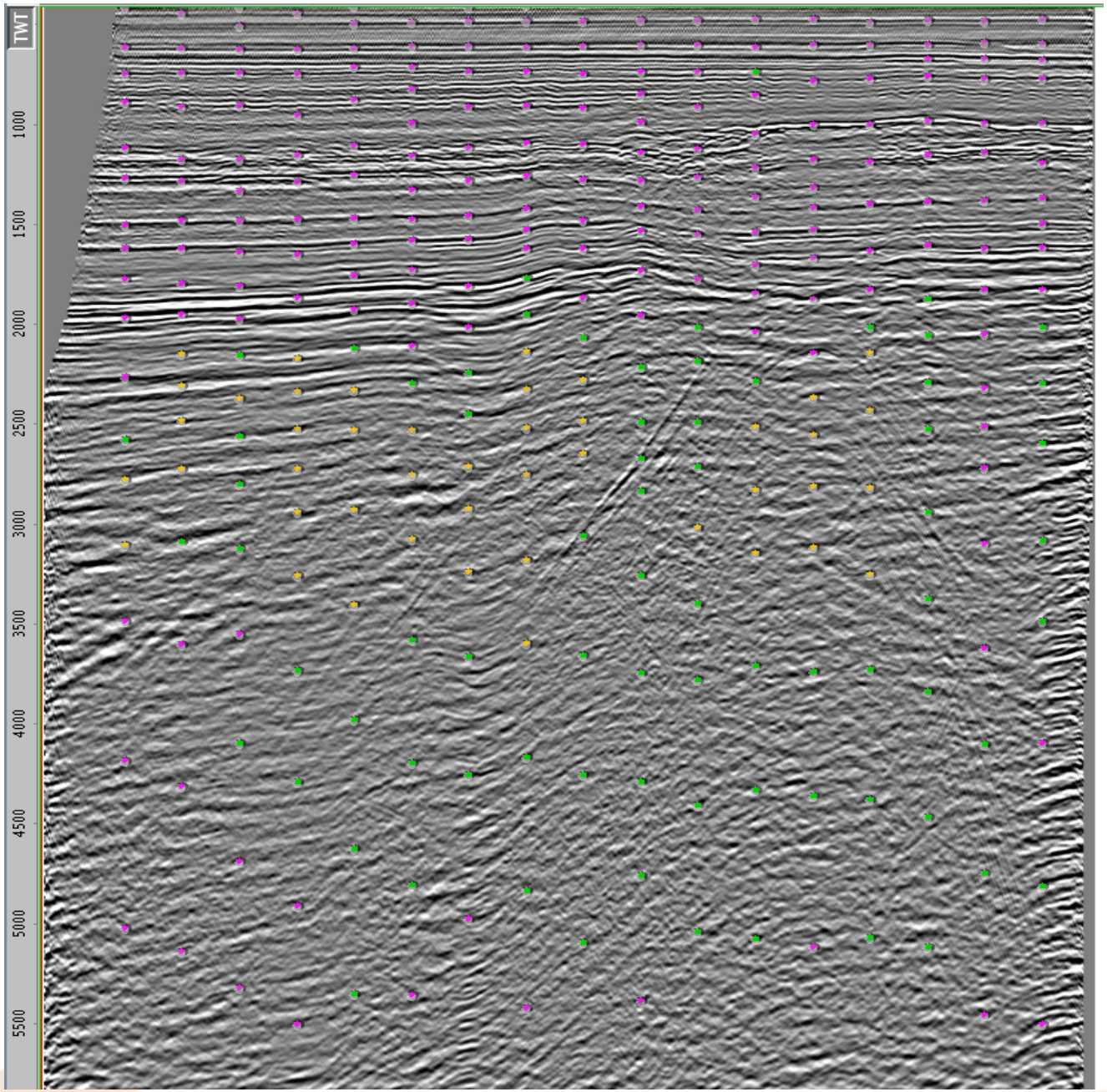
YOL00427: Stack 1



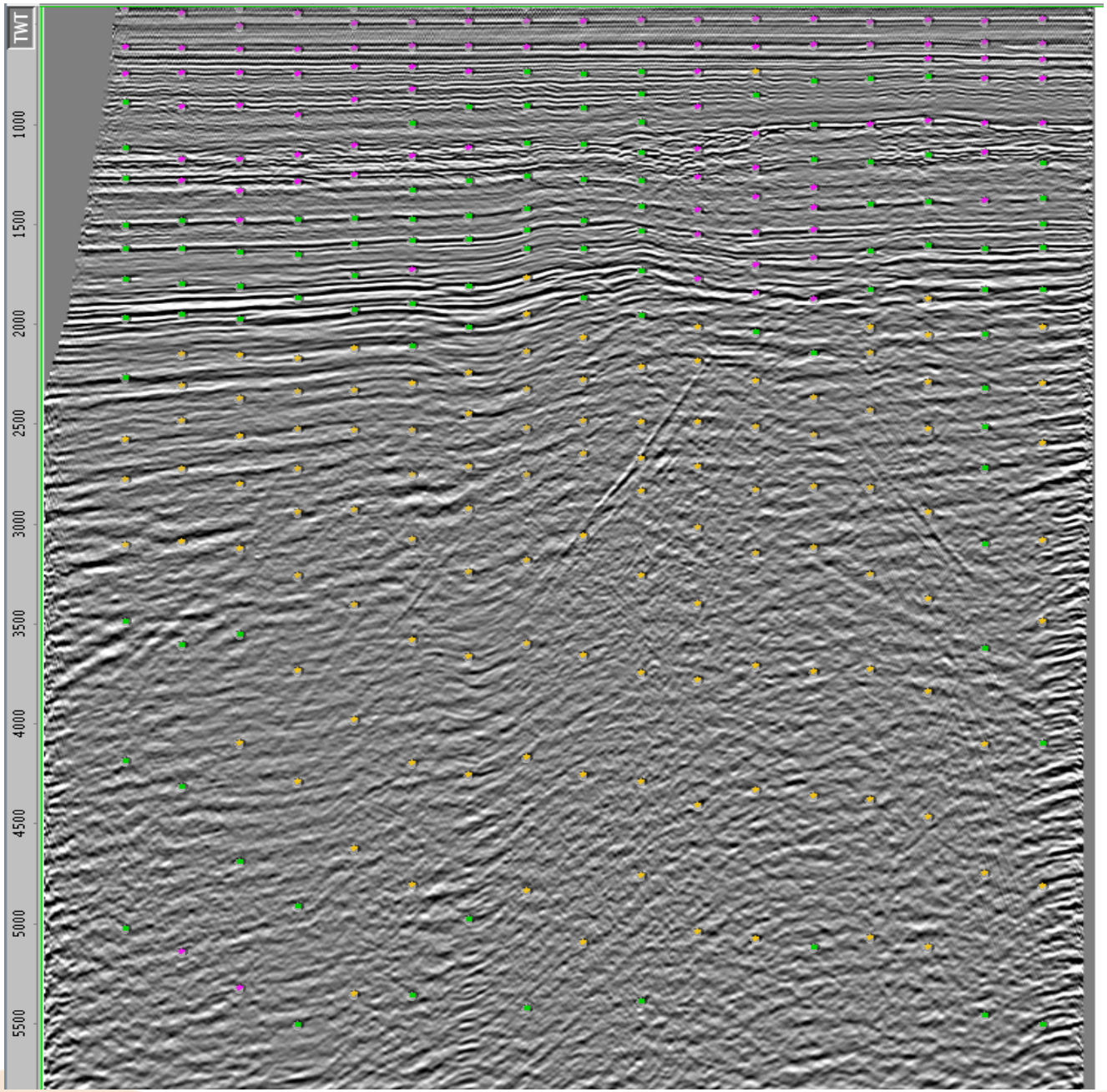
YOL00427: Stack 2



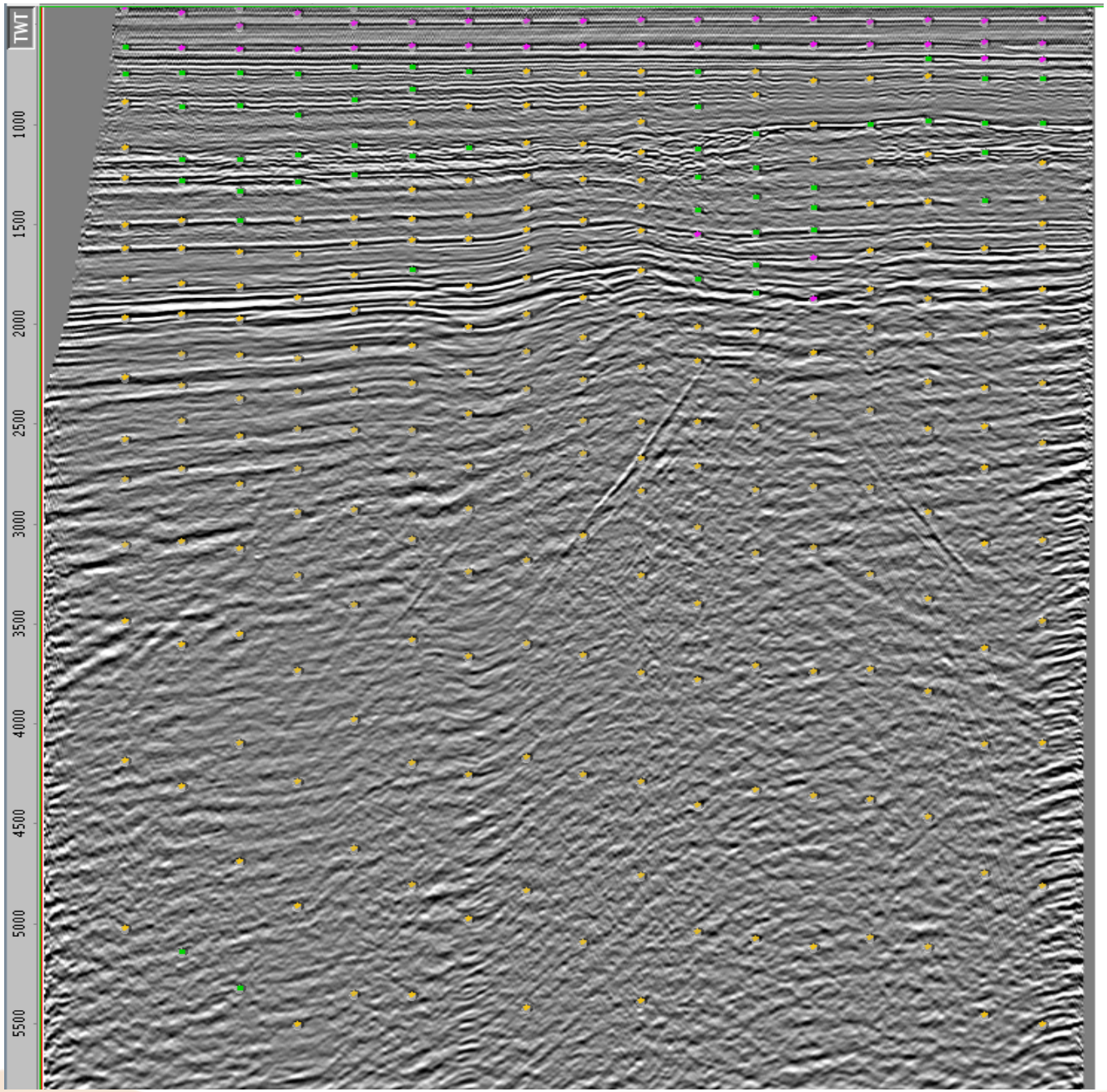
YOL00427: Stack 3



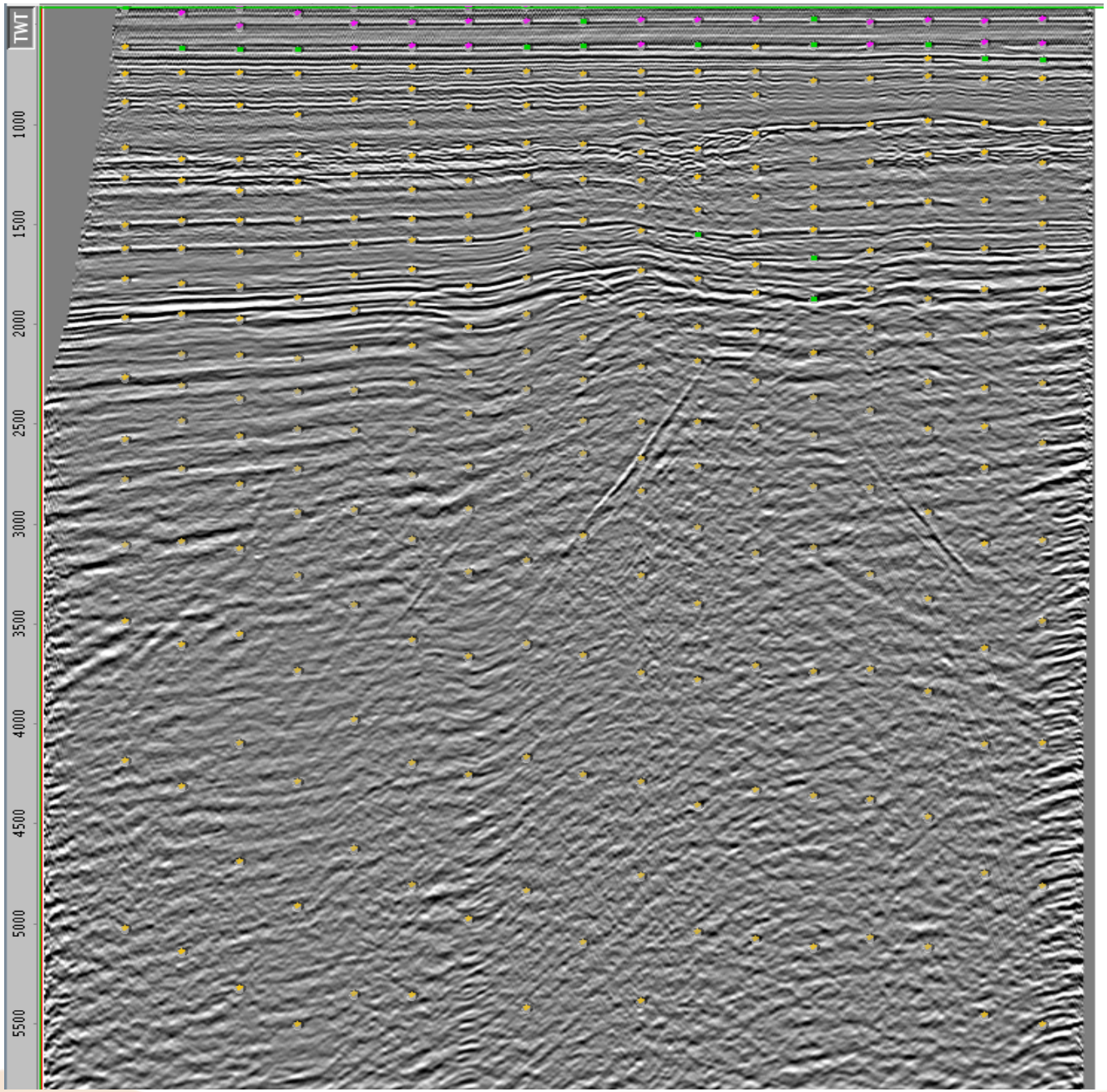
YOL00427: Stack 4



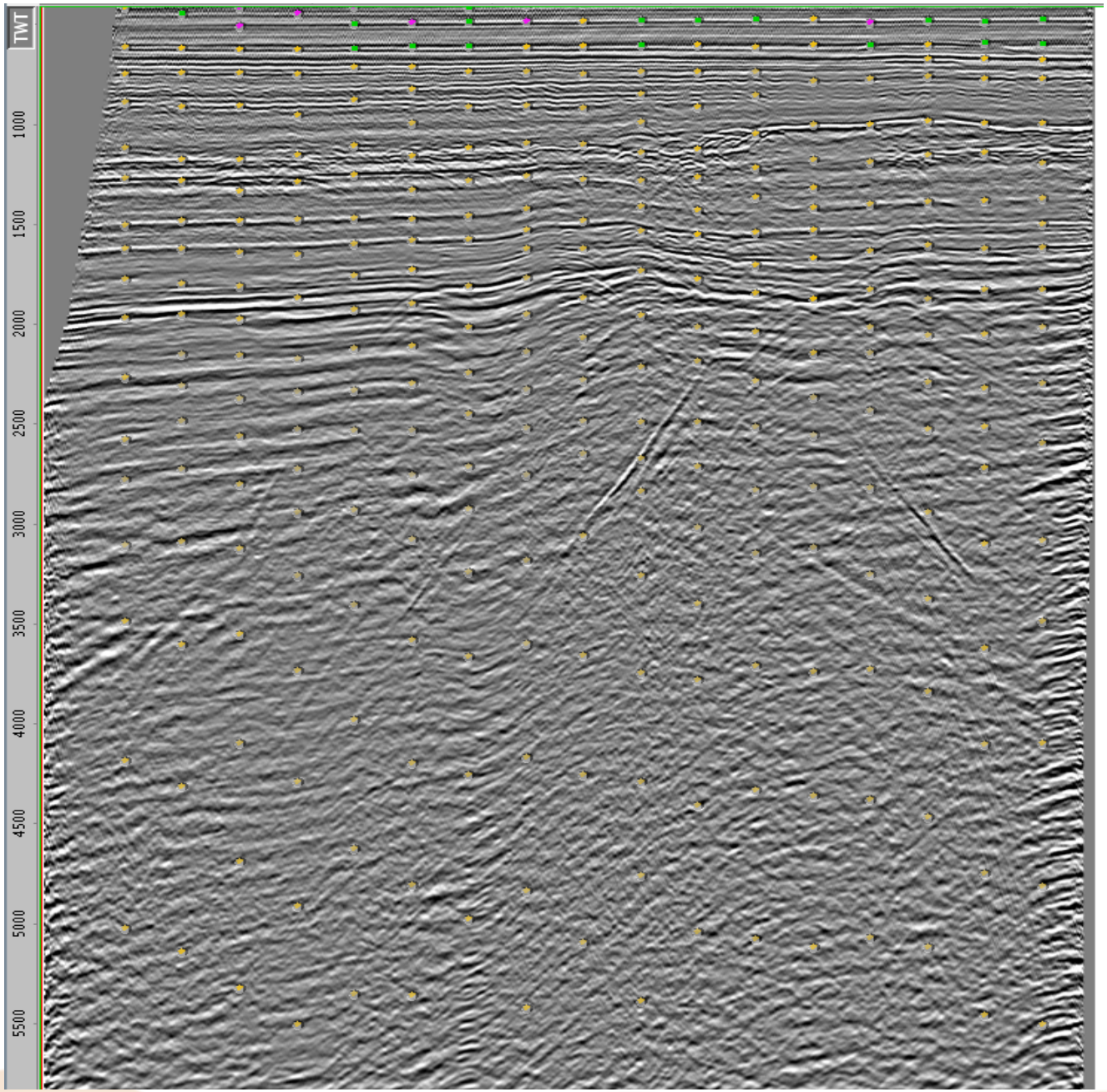
YOL00427: Stack 5



YOL00427: Stack 6



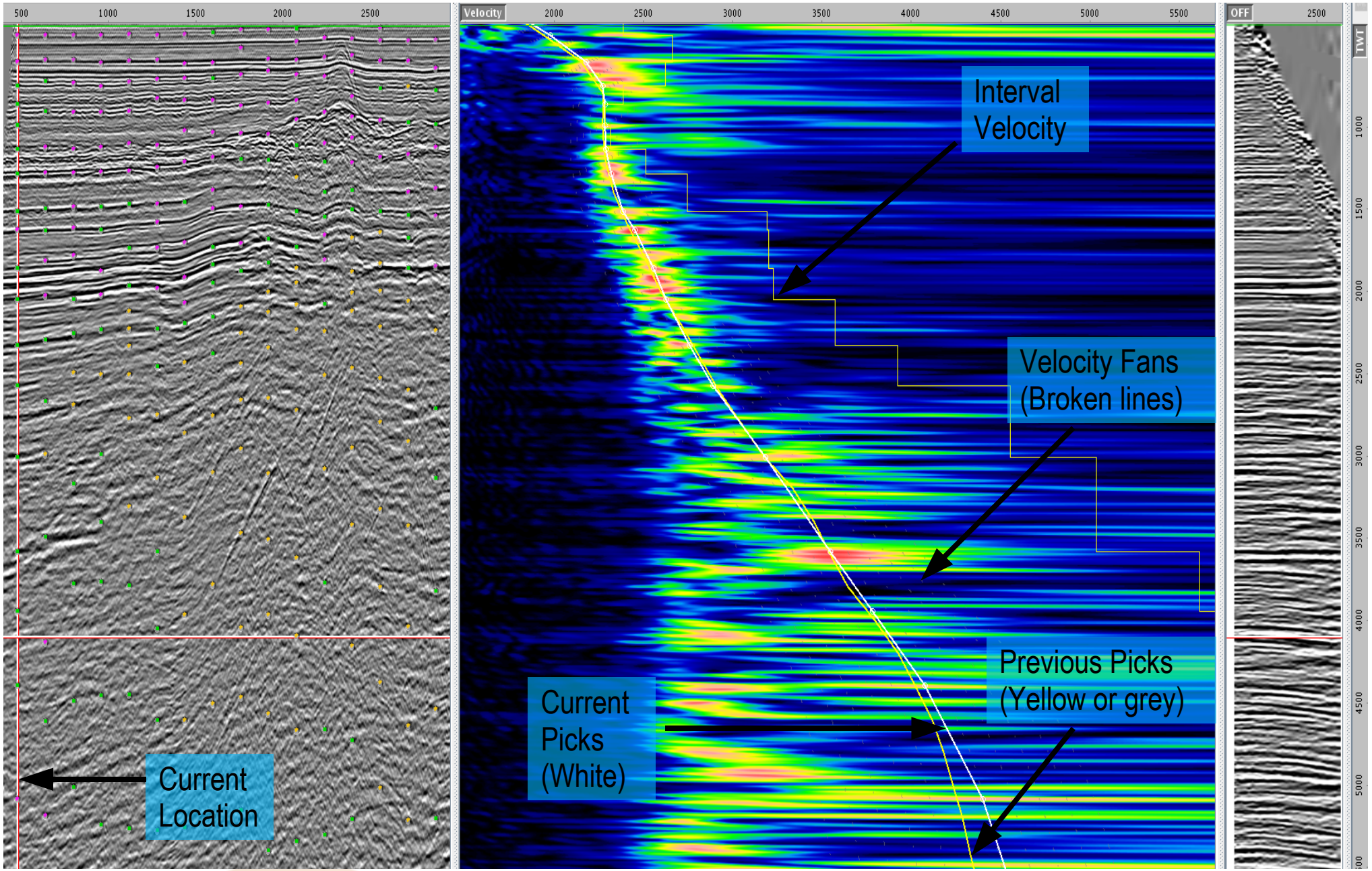
YOL00427: Stack 7



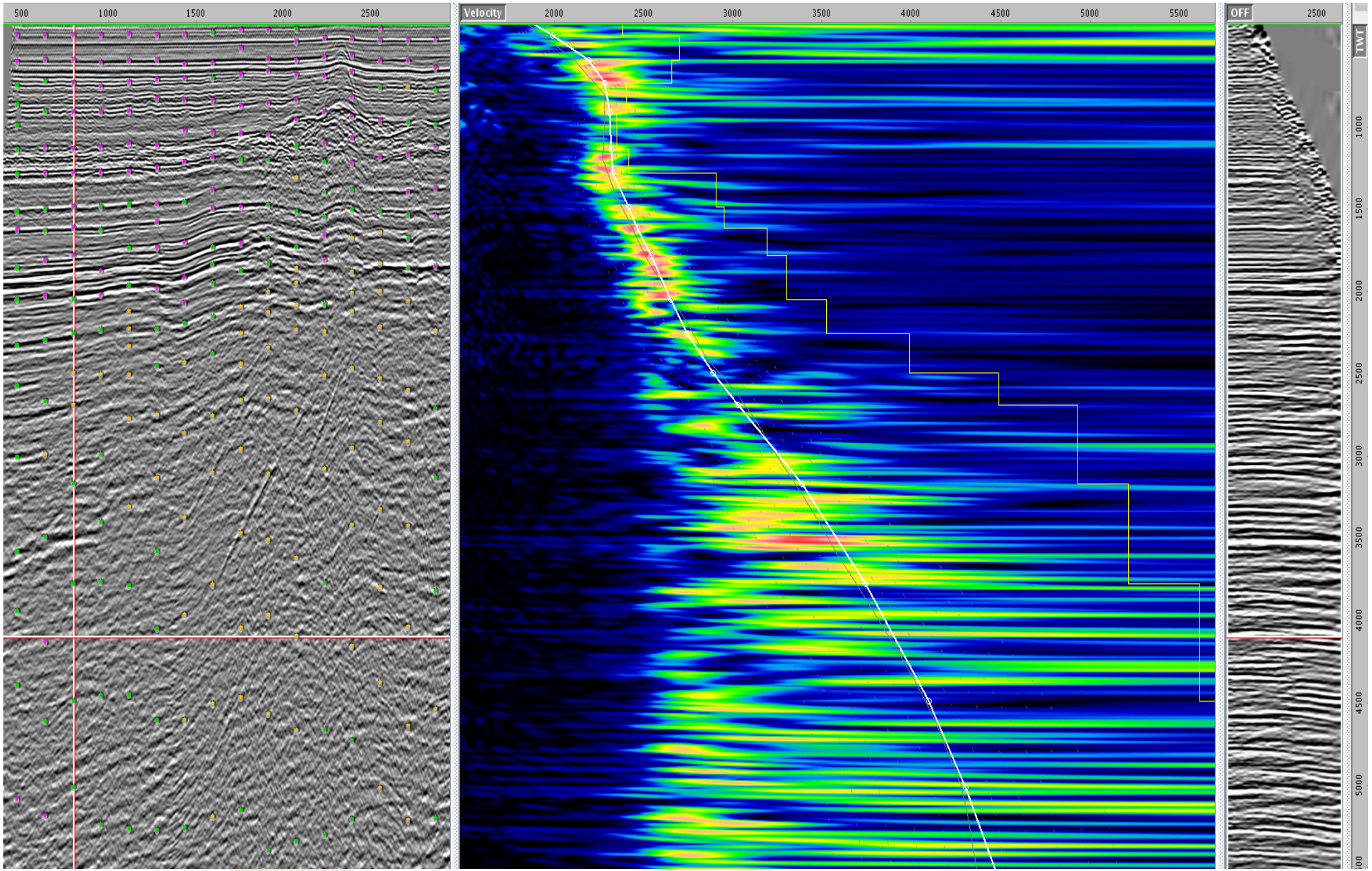
Picking velocities: Semblance plots

- The DUG velocity picking program also has a semblance based picking functionality. Included on this display is the interval velocity profile, the current RMS profile and the old velocity profile (including the fans mentioned above).
- Below are images of the semblance and gather every 2km along both testlines. An image of the stack has been included for reference.

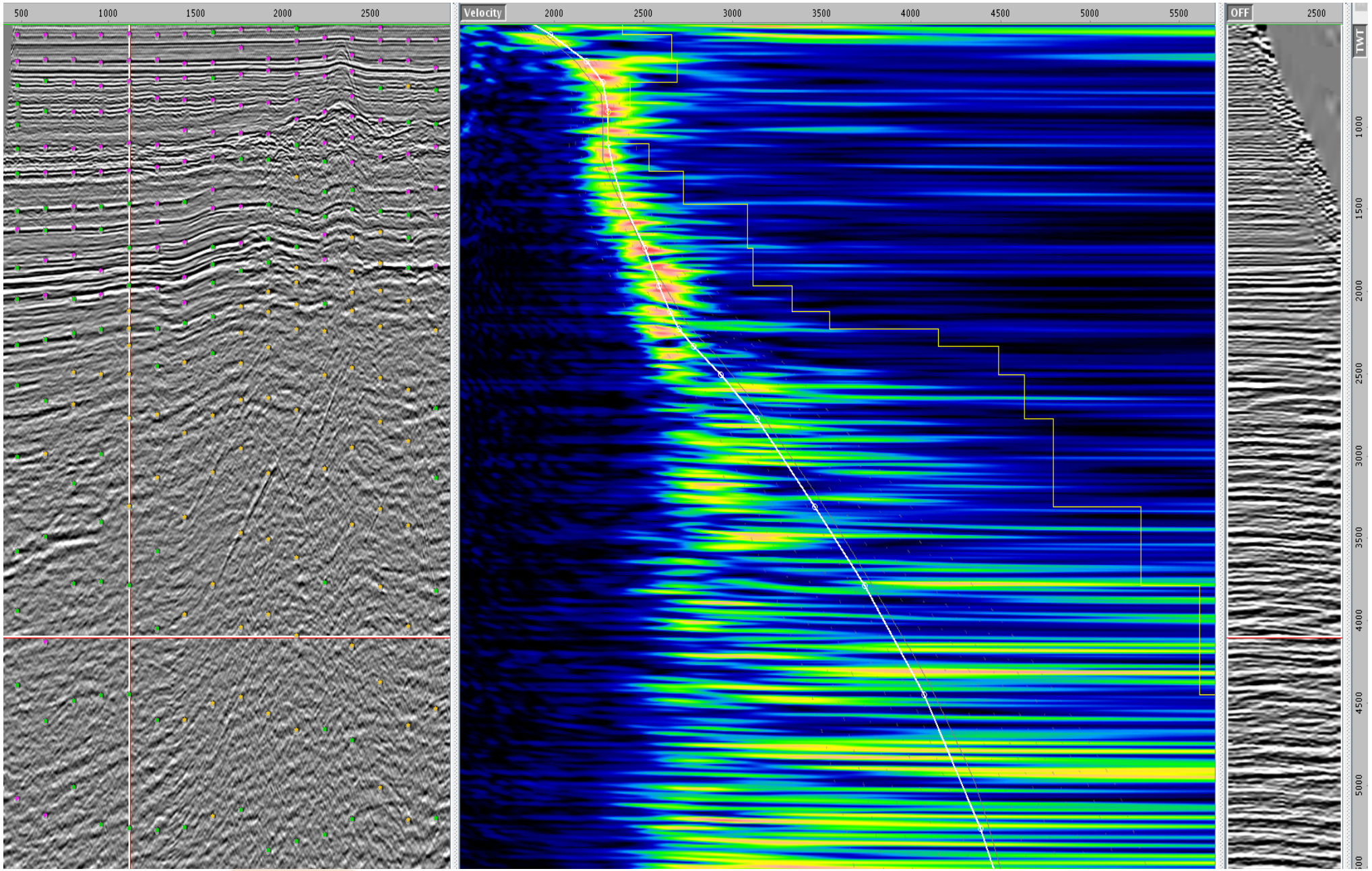
YOL00493: Semblance



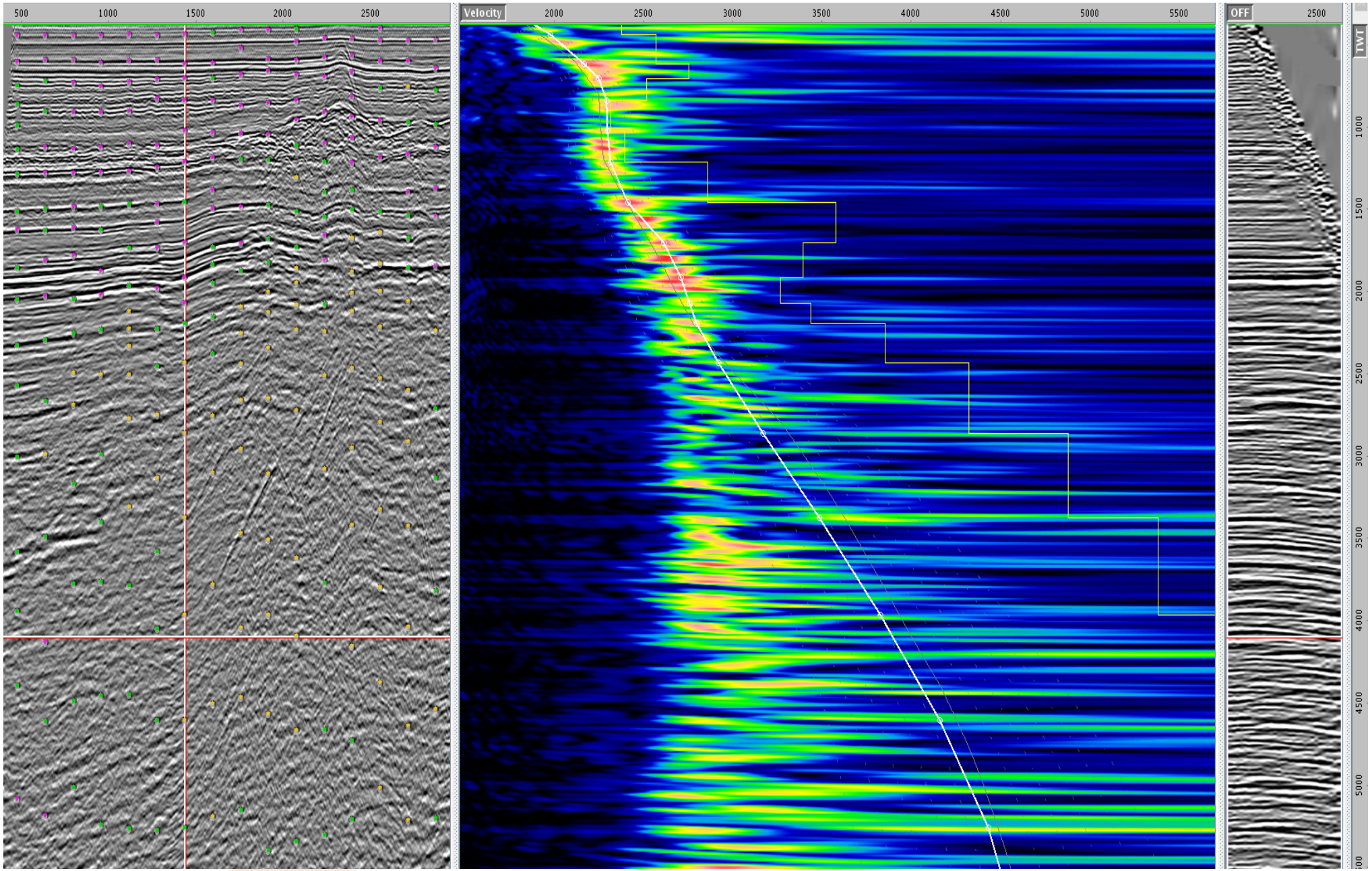
YOL00493: Semblance



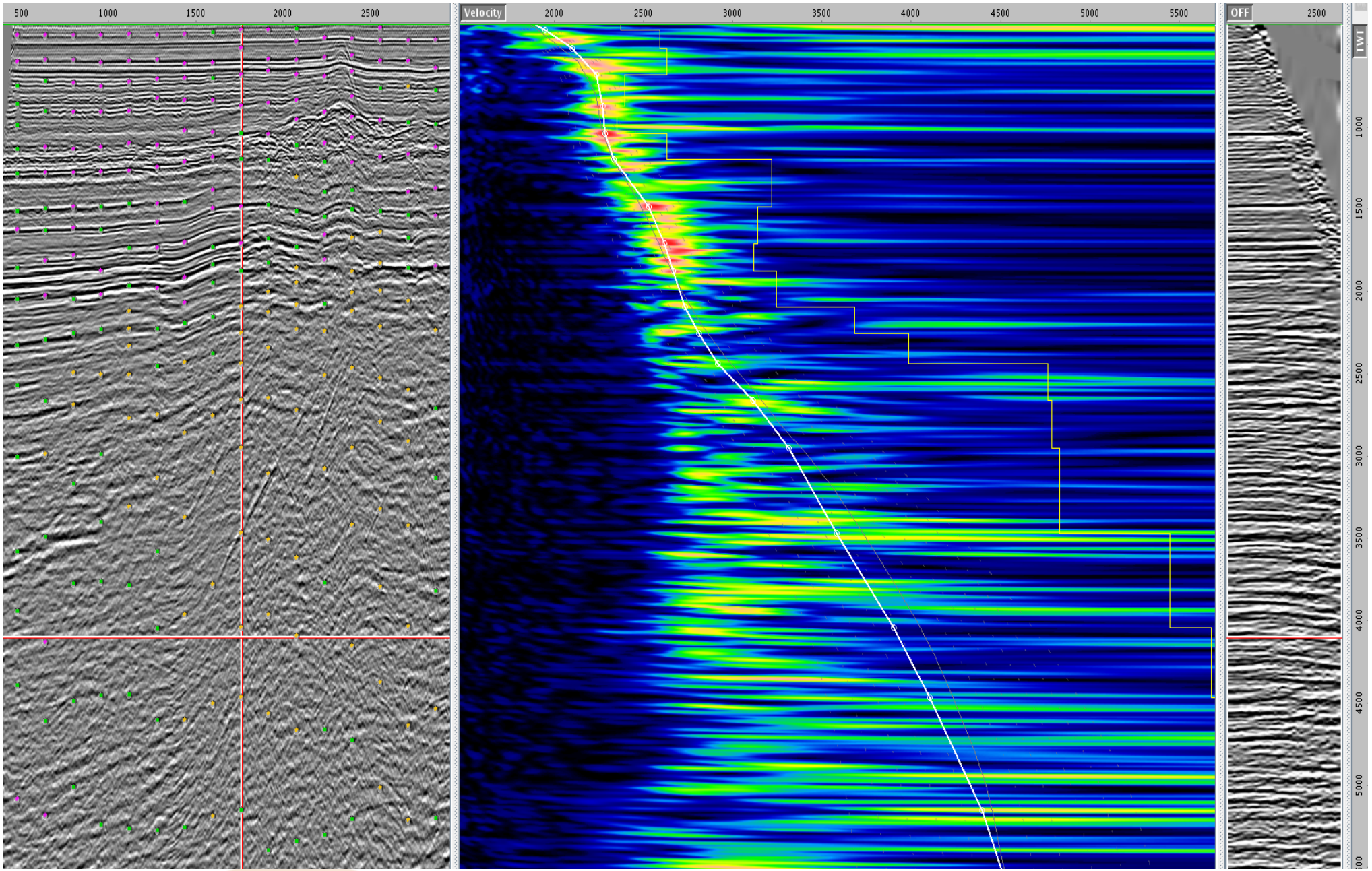
YOL00493: Semblance



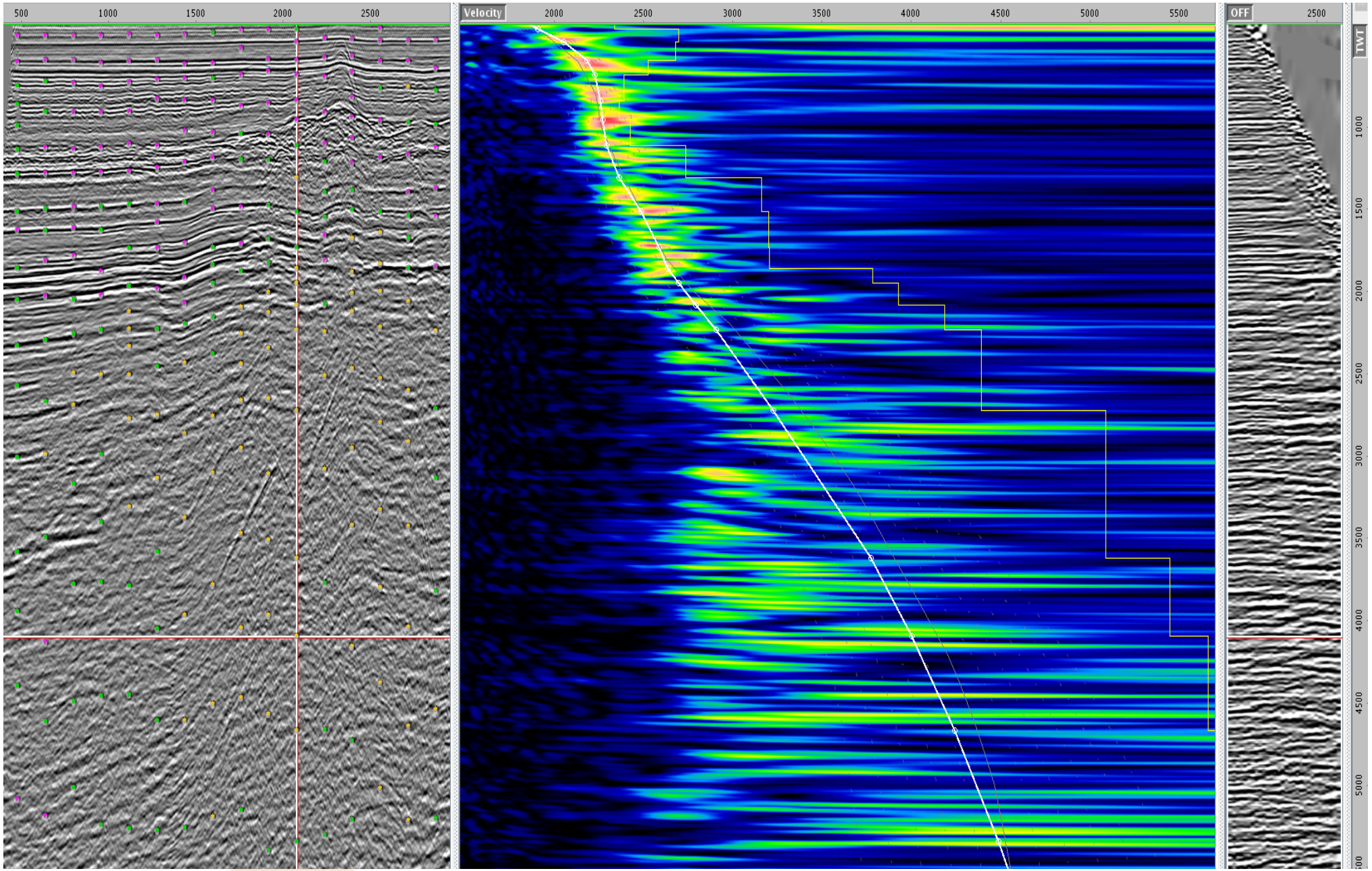
YOL00493: Semblance



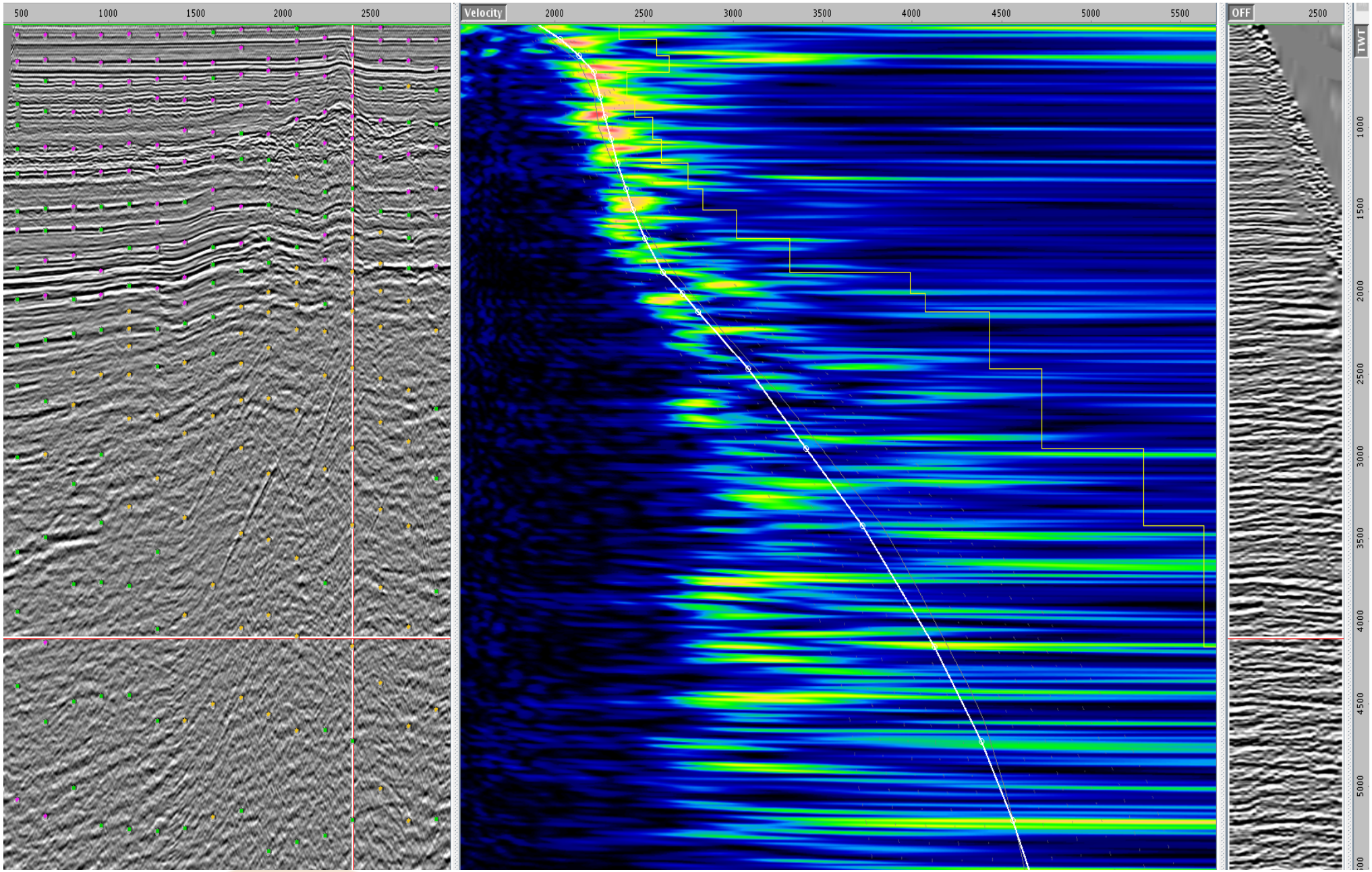
YOL00493: Semblance



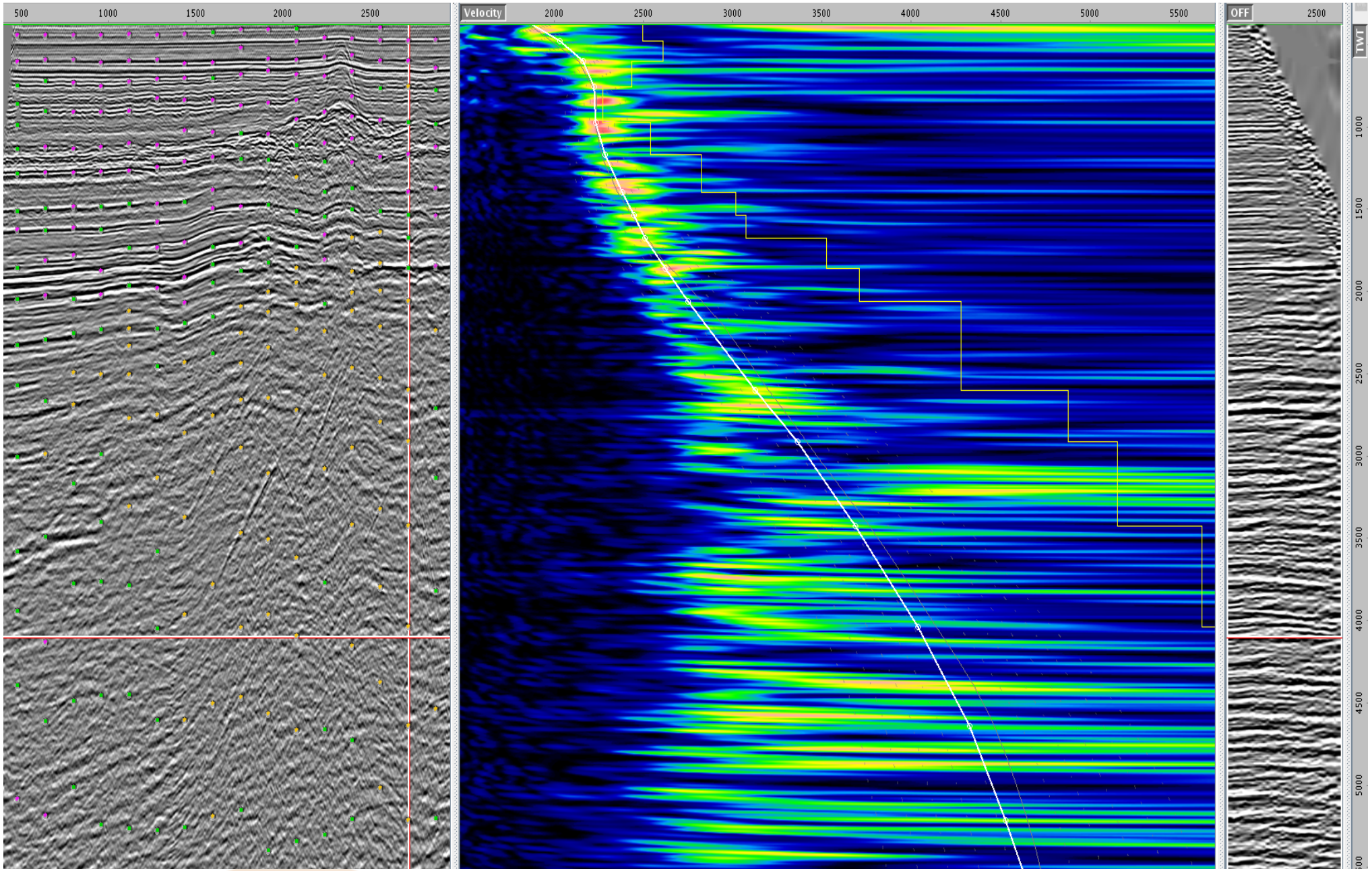
YOL00493: Semblance



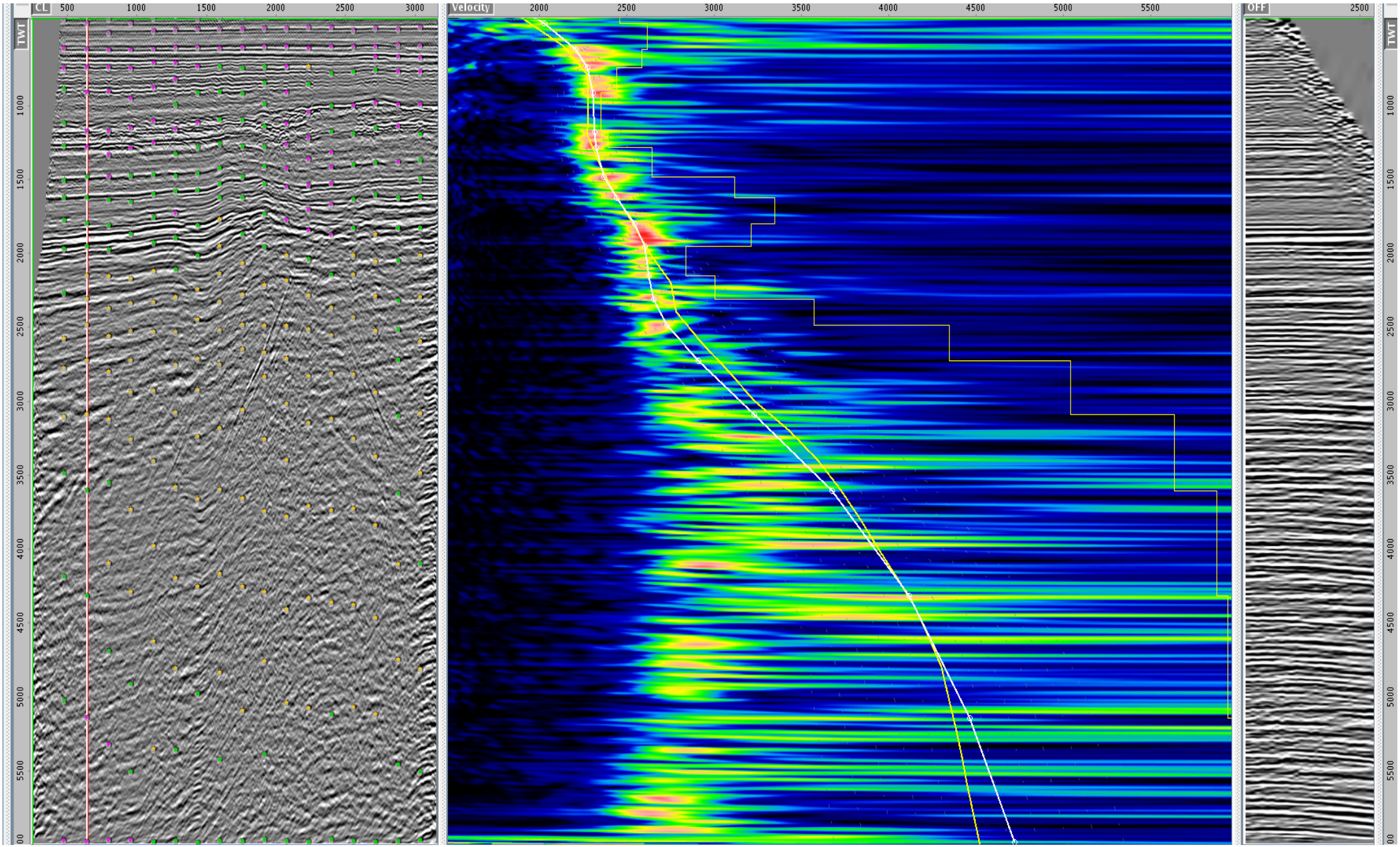
YOL00493: Semblance



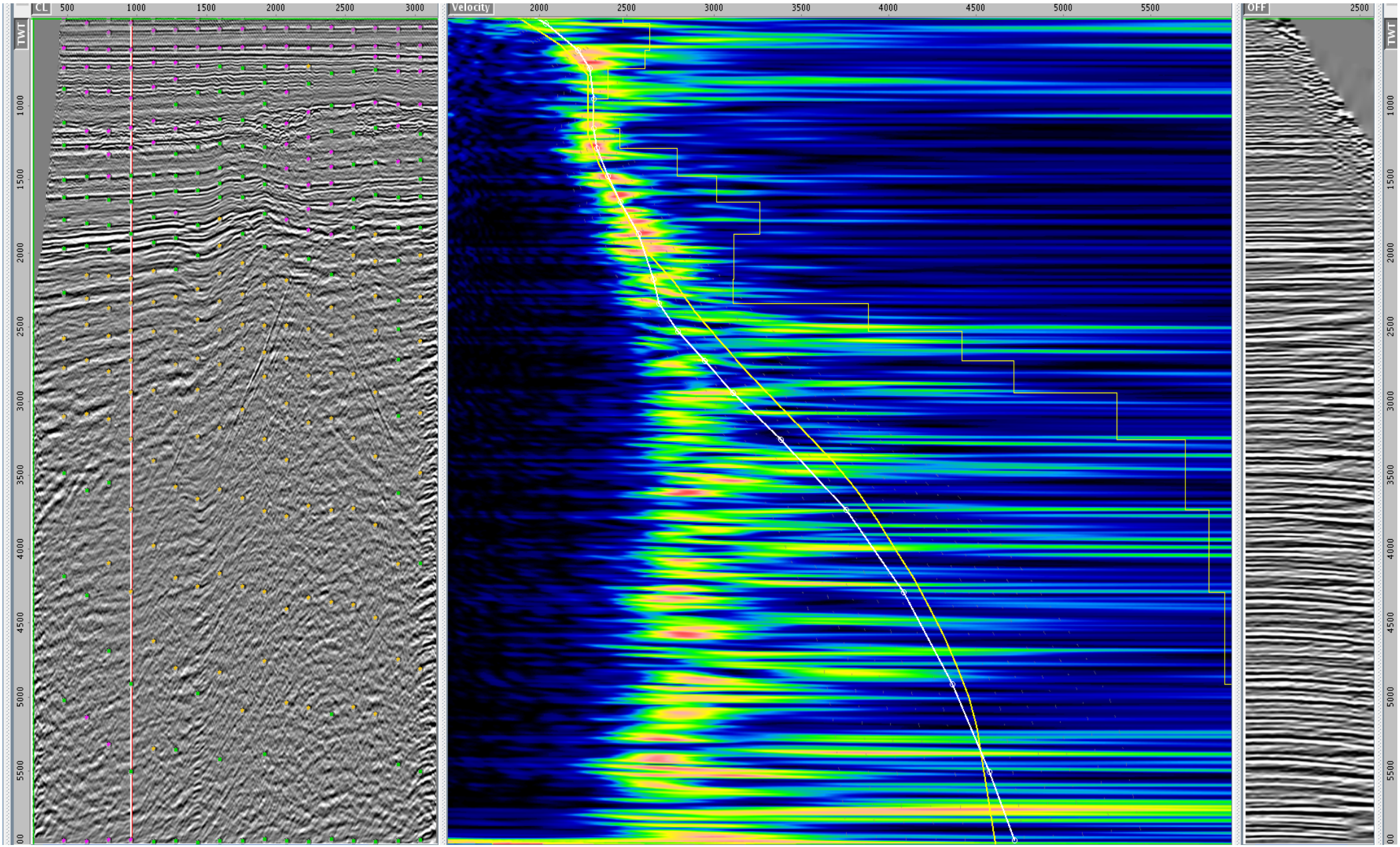
YOL00493: Semblance



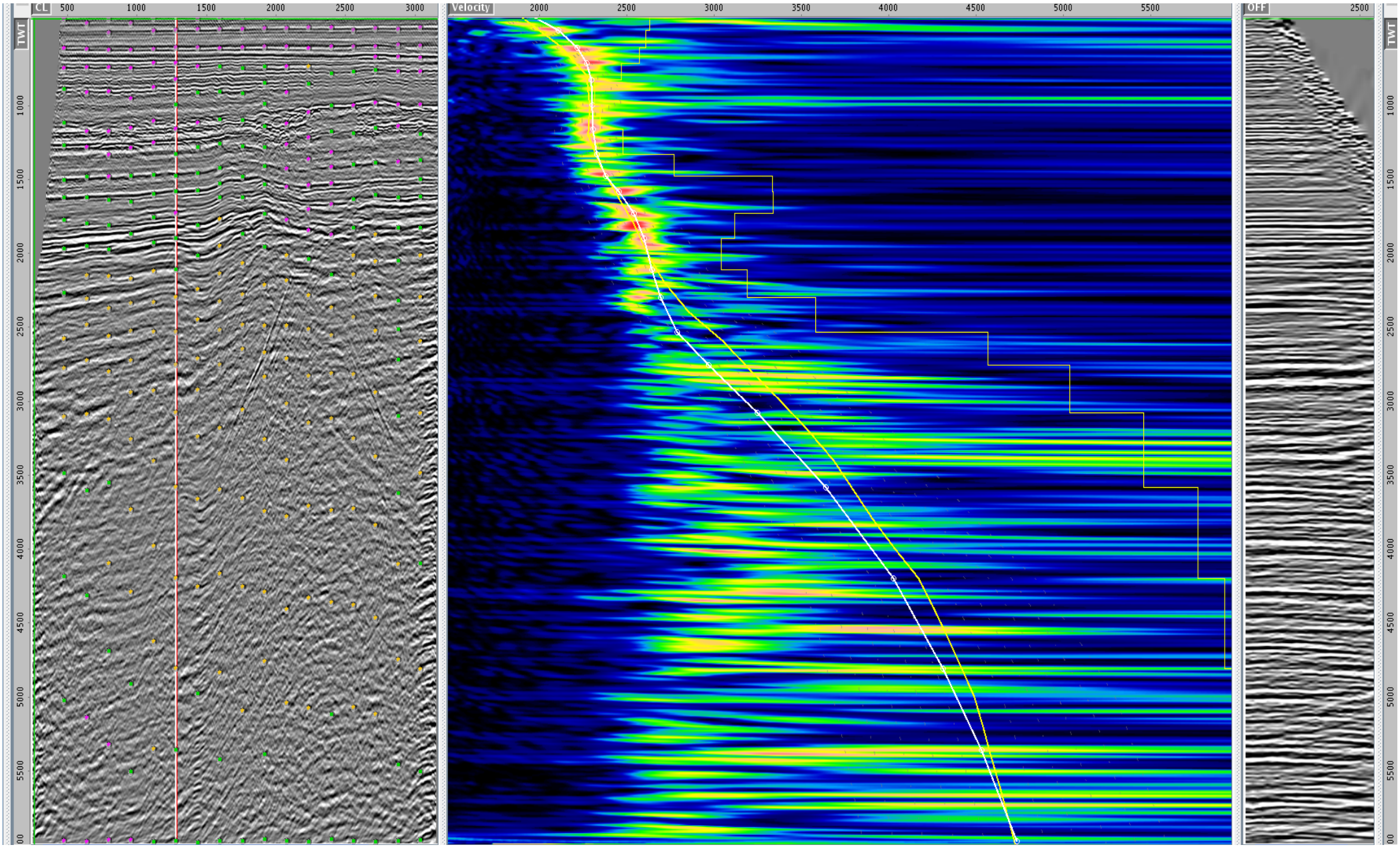
YOL00427: Semblance



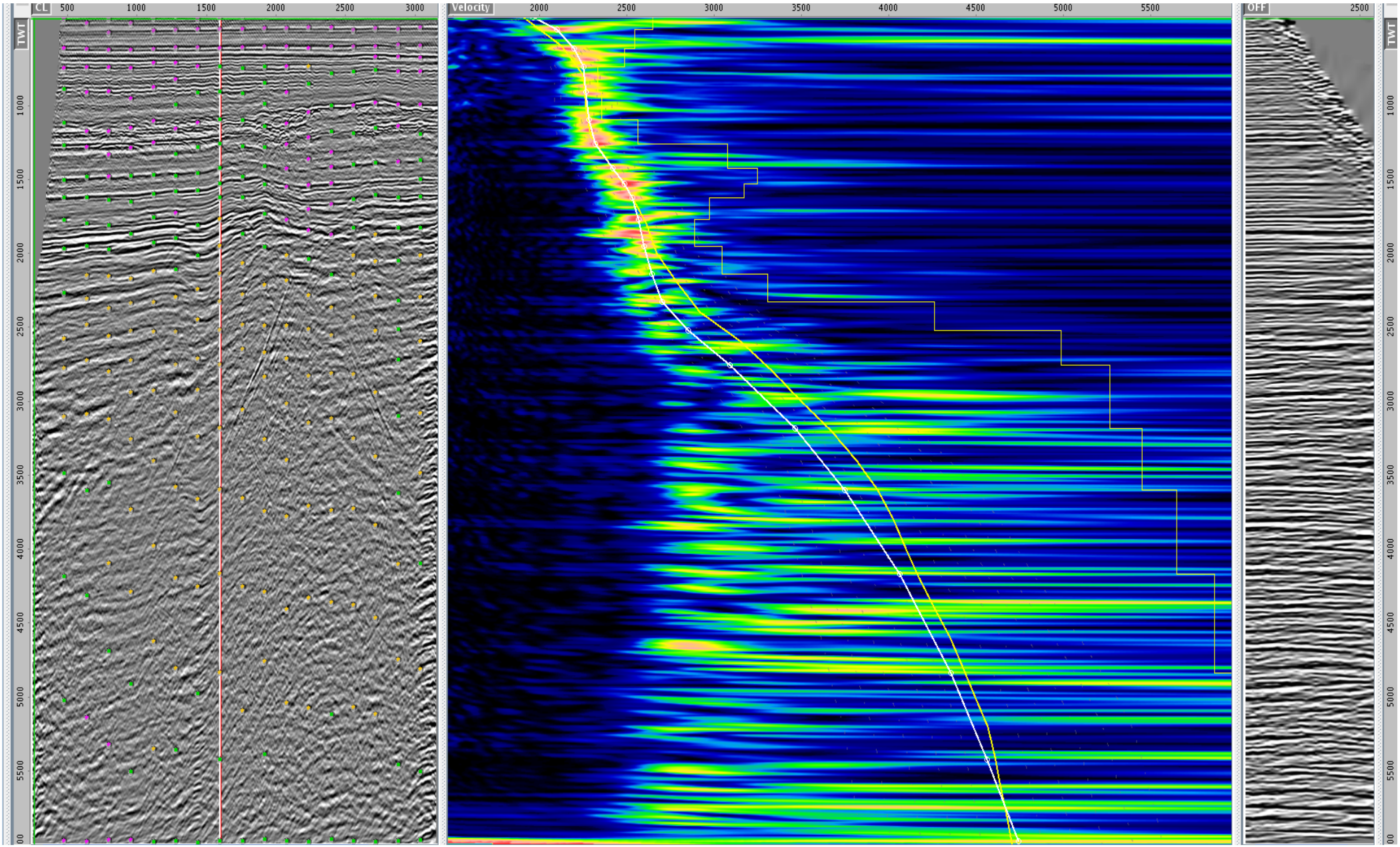
YOL00427: Semblance



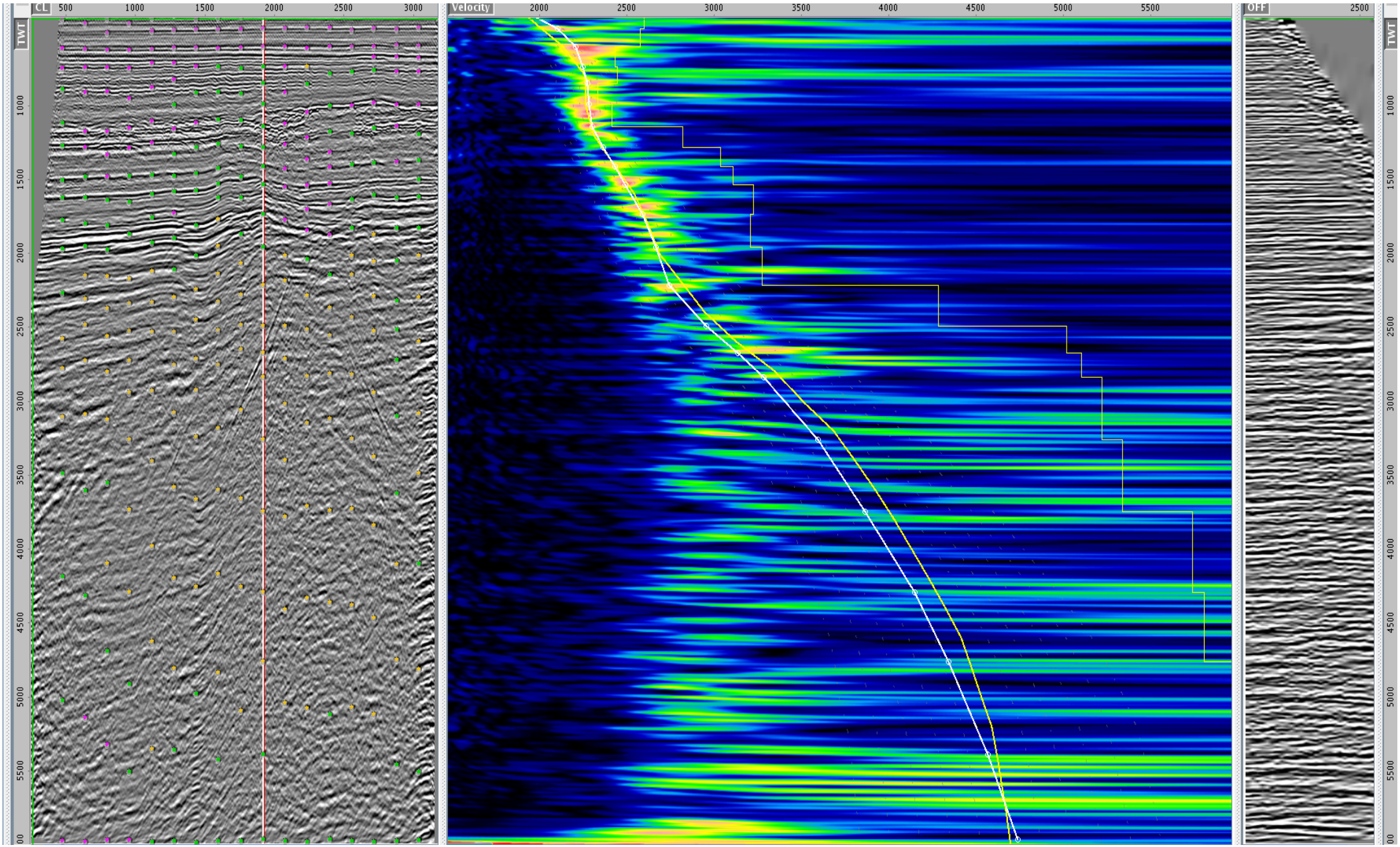
YOL00427: Semblance



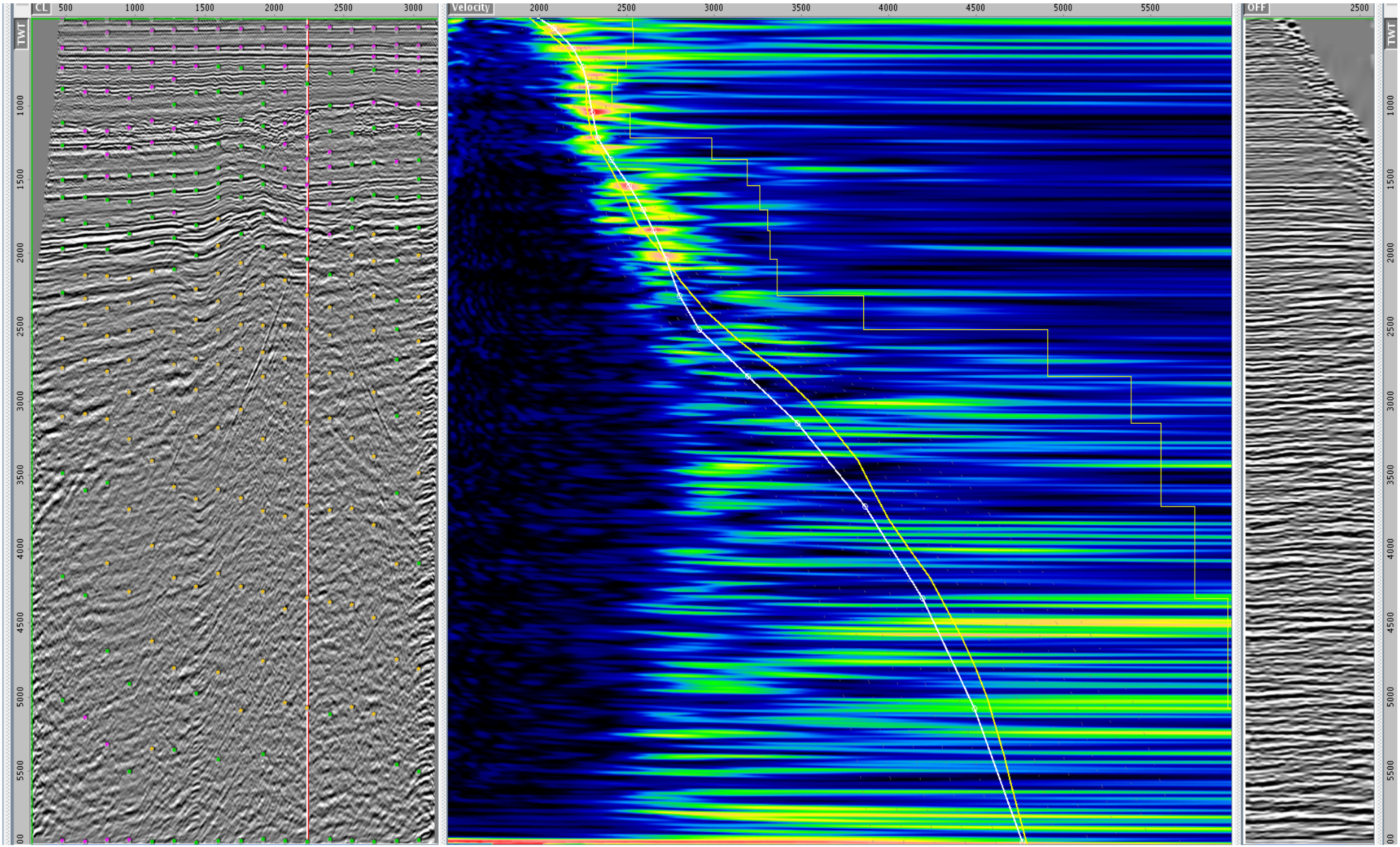
YOL00427: Semblance



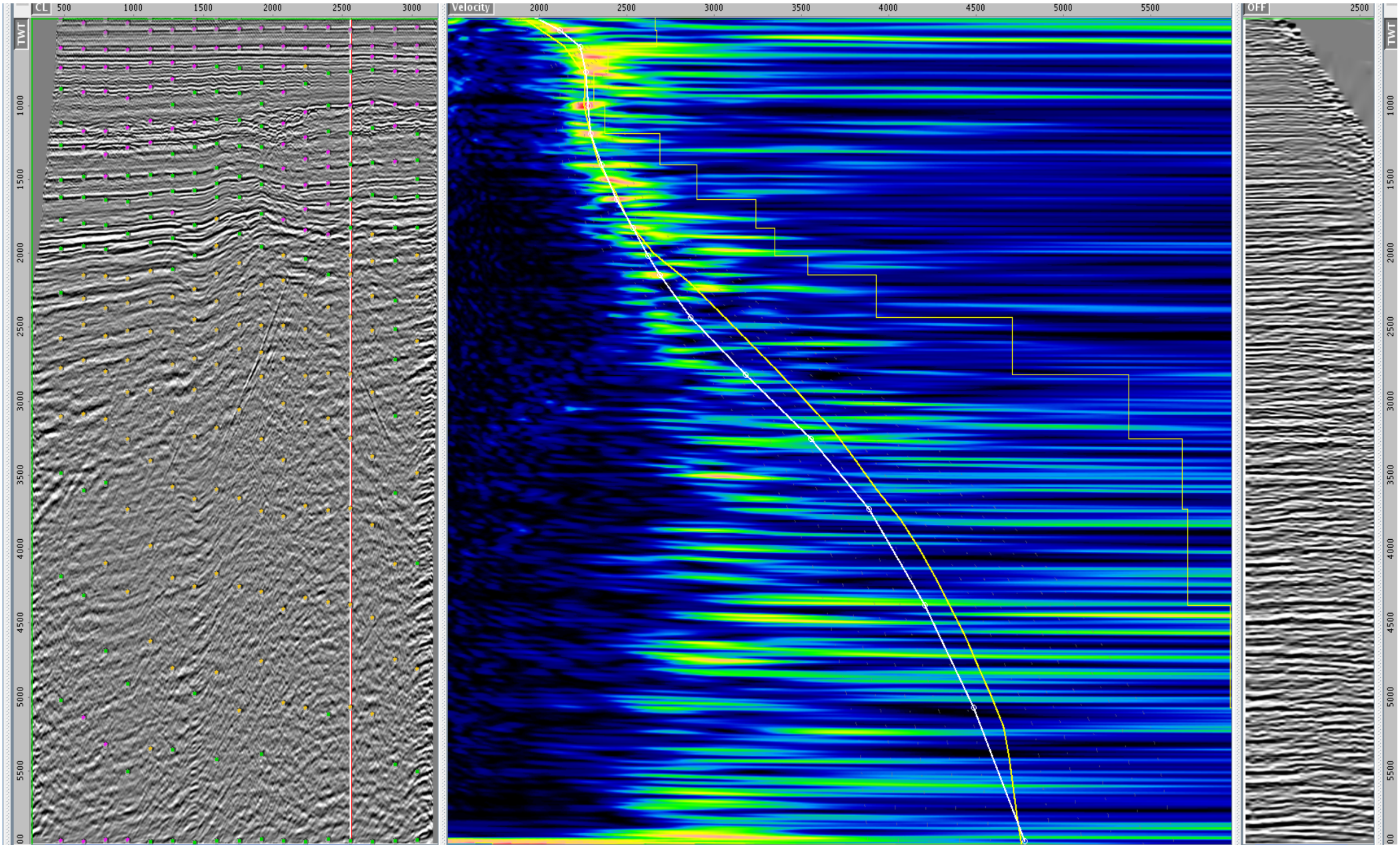
YOL00427: Semblance



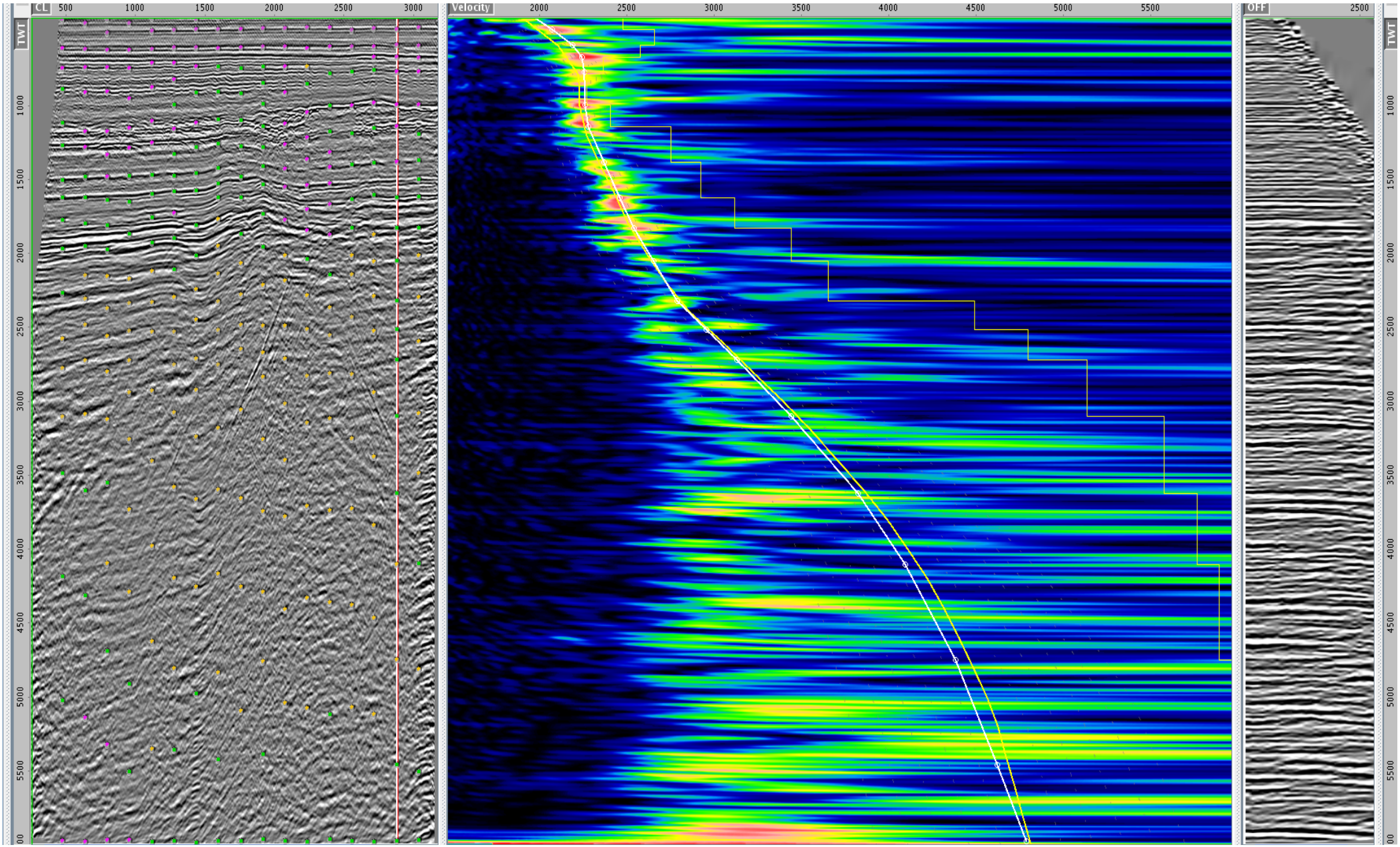
YOL00427: Semblance



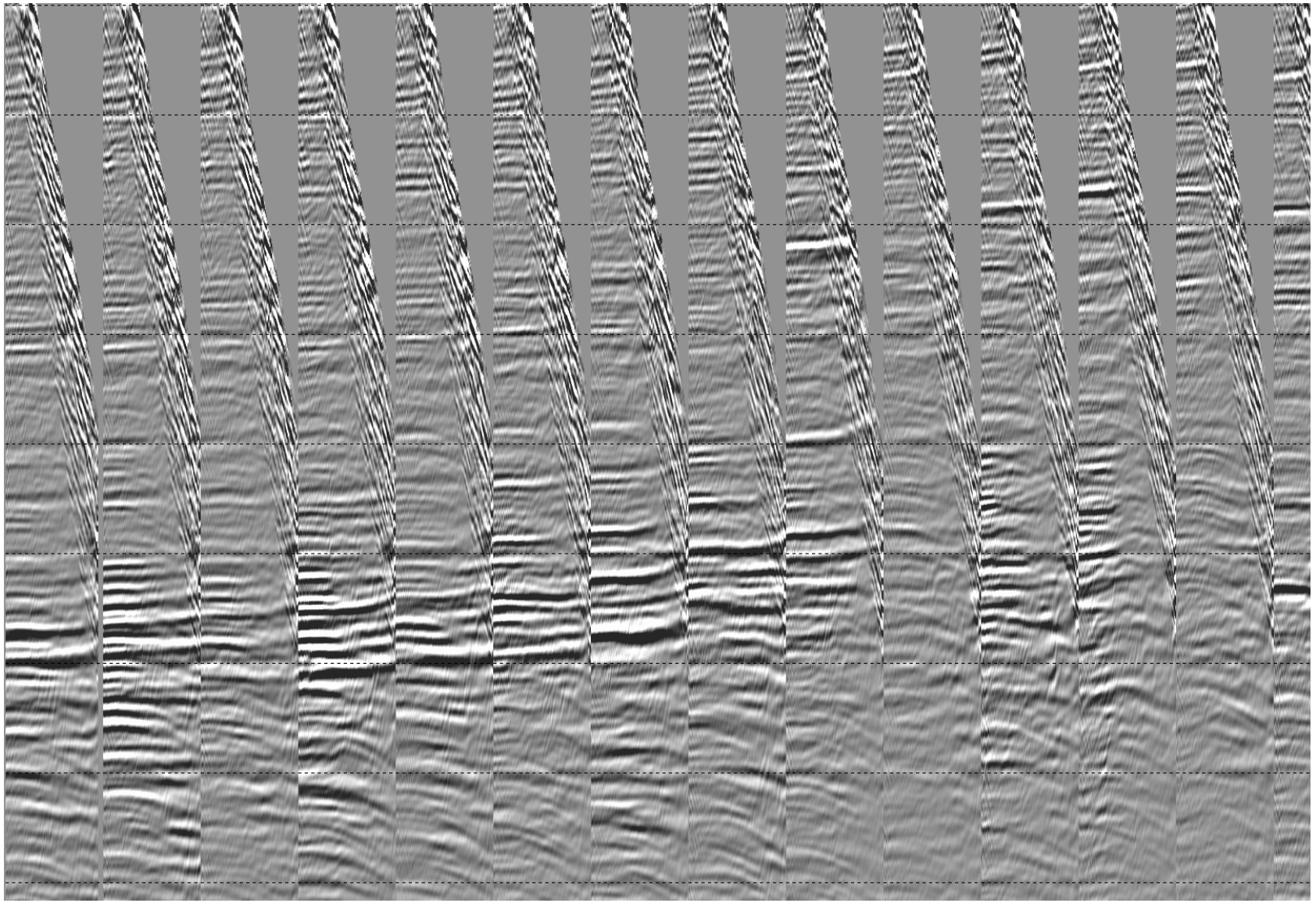
YOL00427: Semblance



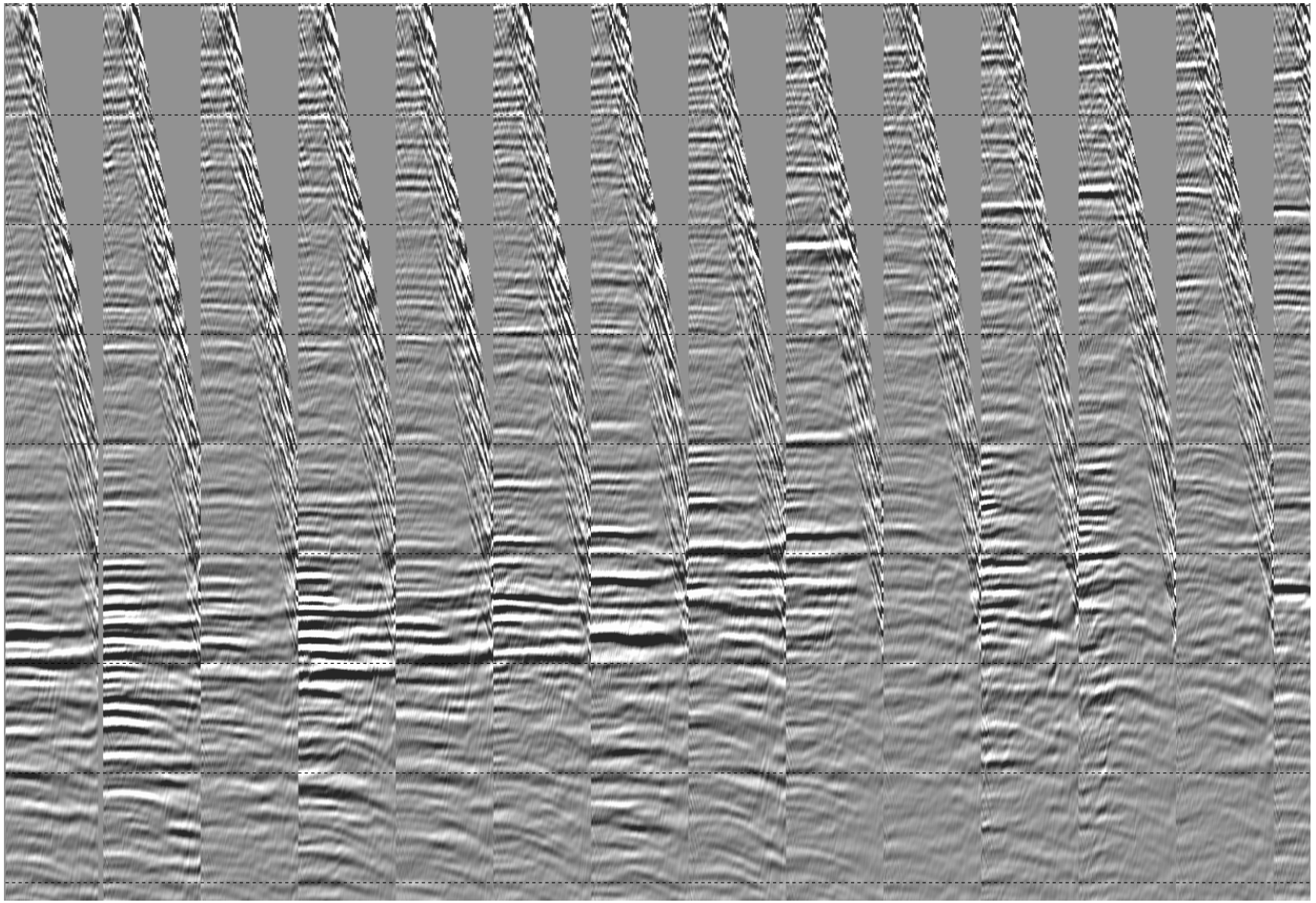
YOL00427: Semblance



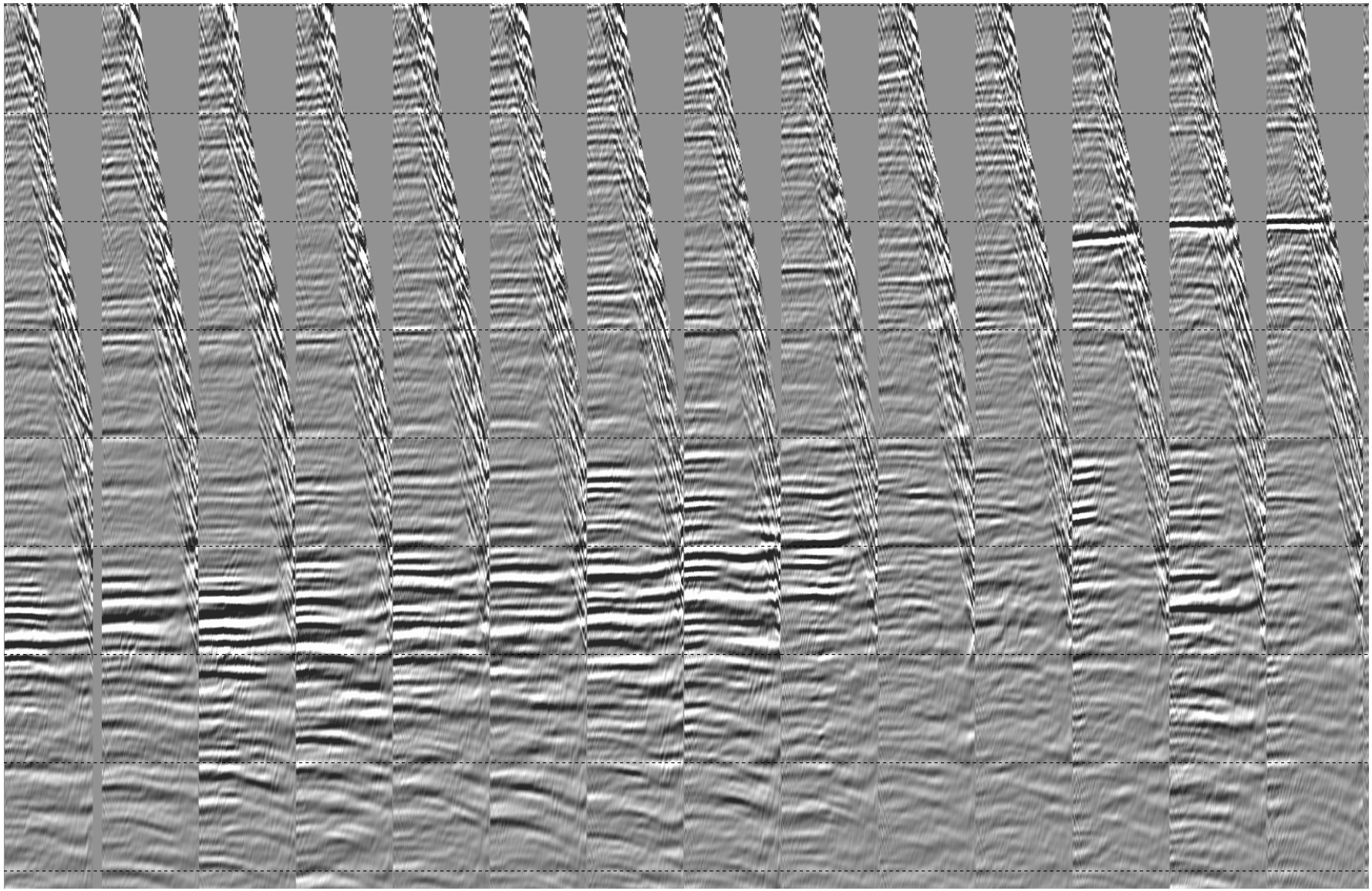
Gathers YOL00493: Client Velocities



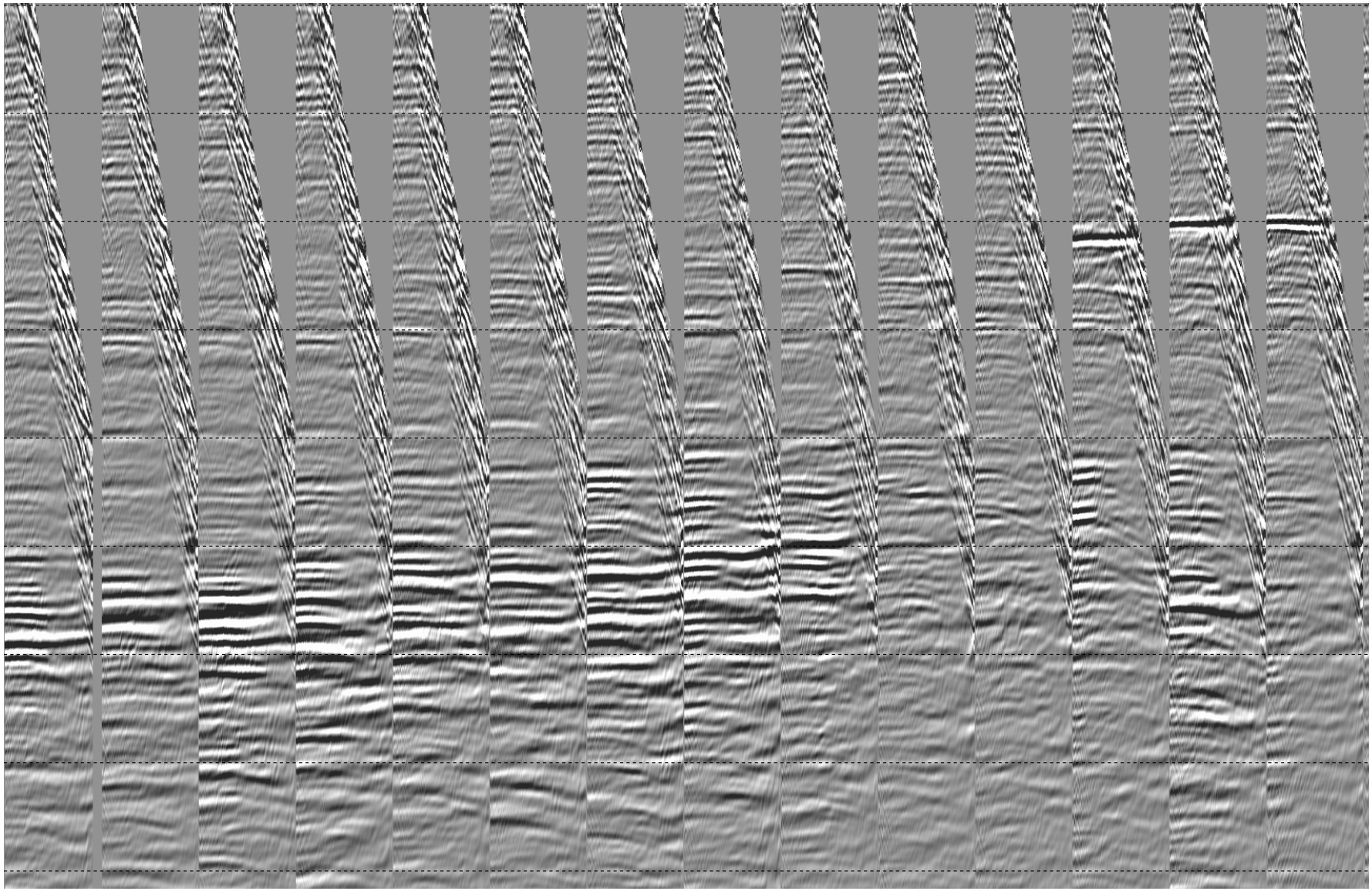
Gathers YOL00493: Radon Velocities



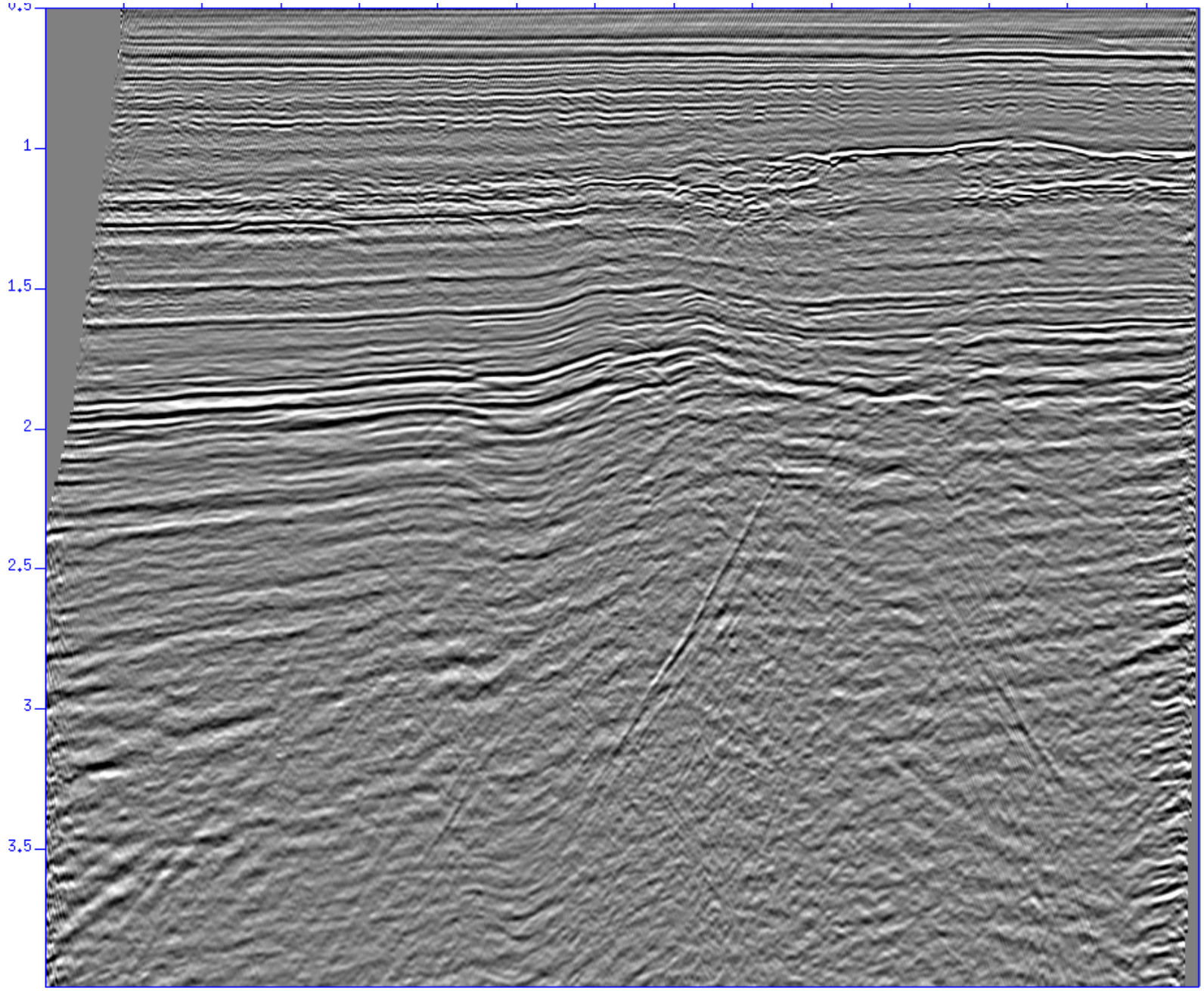
Gathers YOL00427: Client Velocities



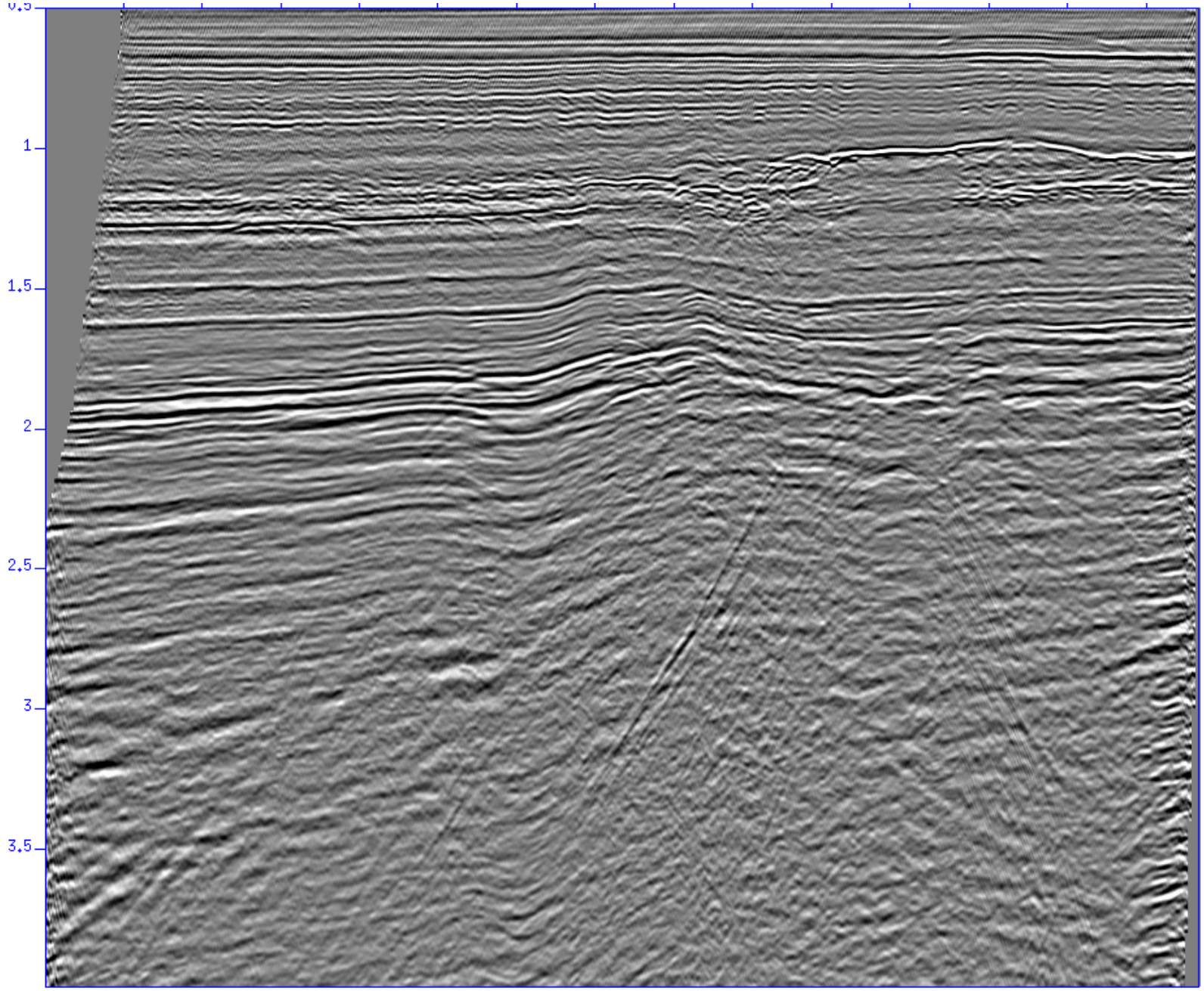
Gathers YOL00427: Radon Velocities



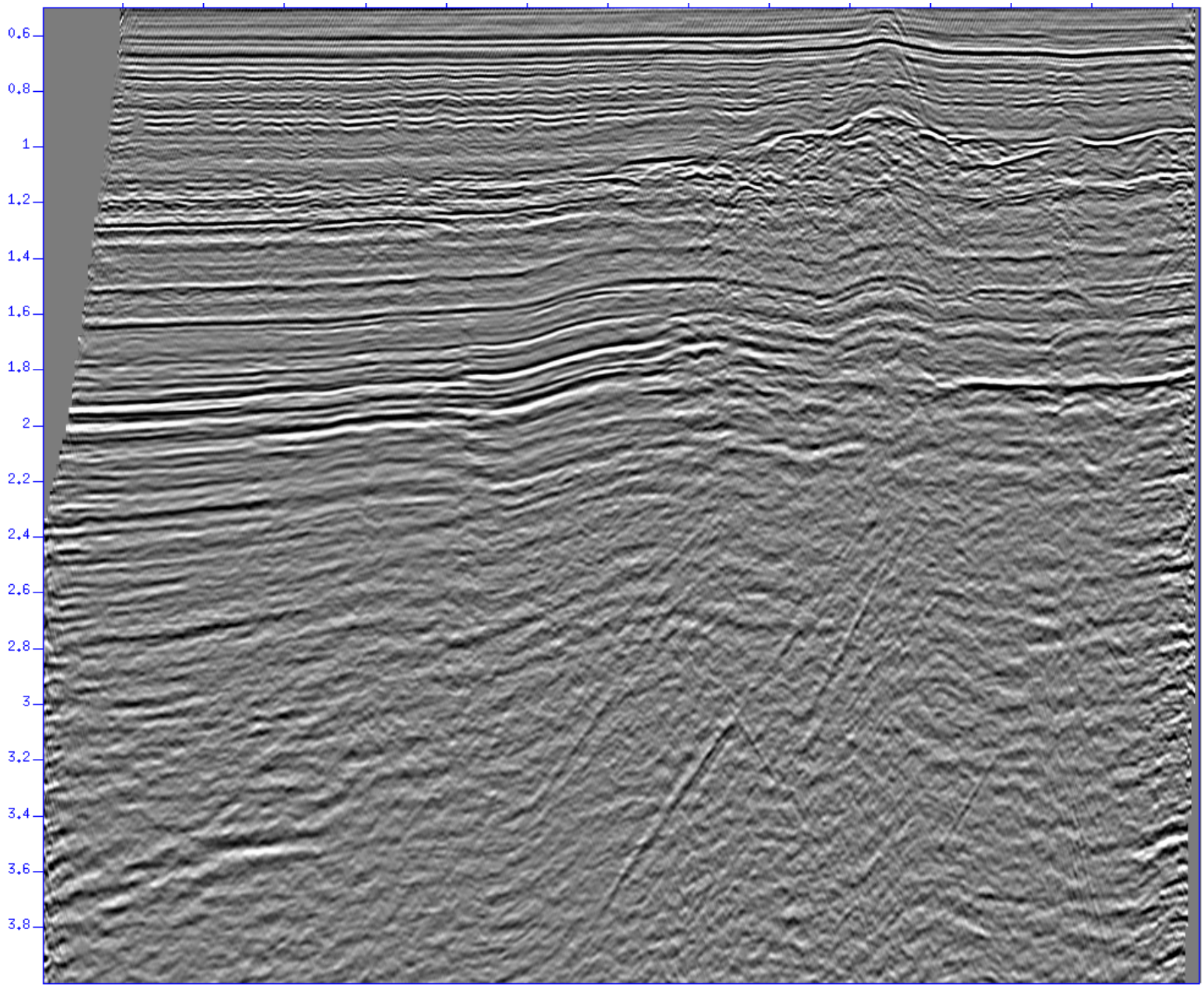
Stack: YOL00427 – Old Velocities



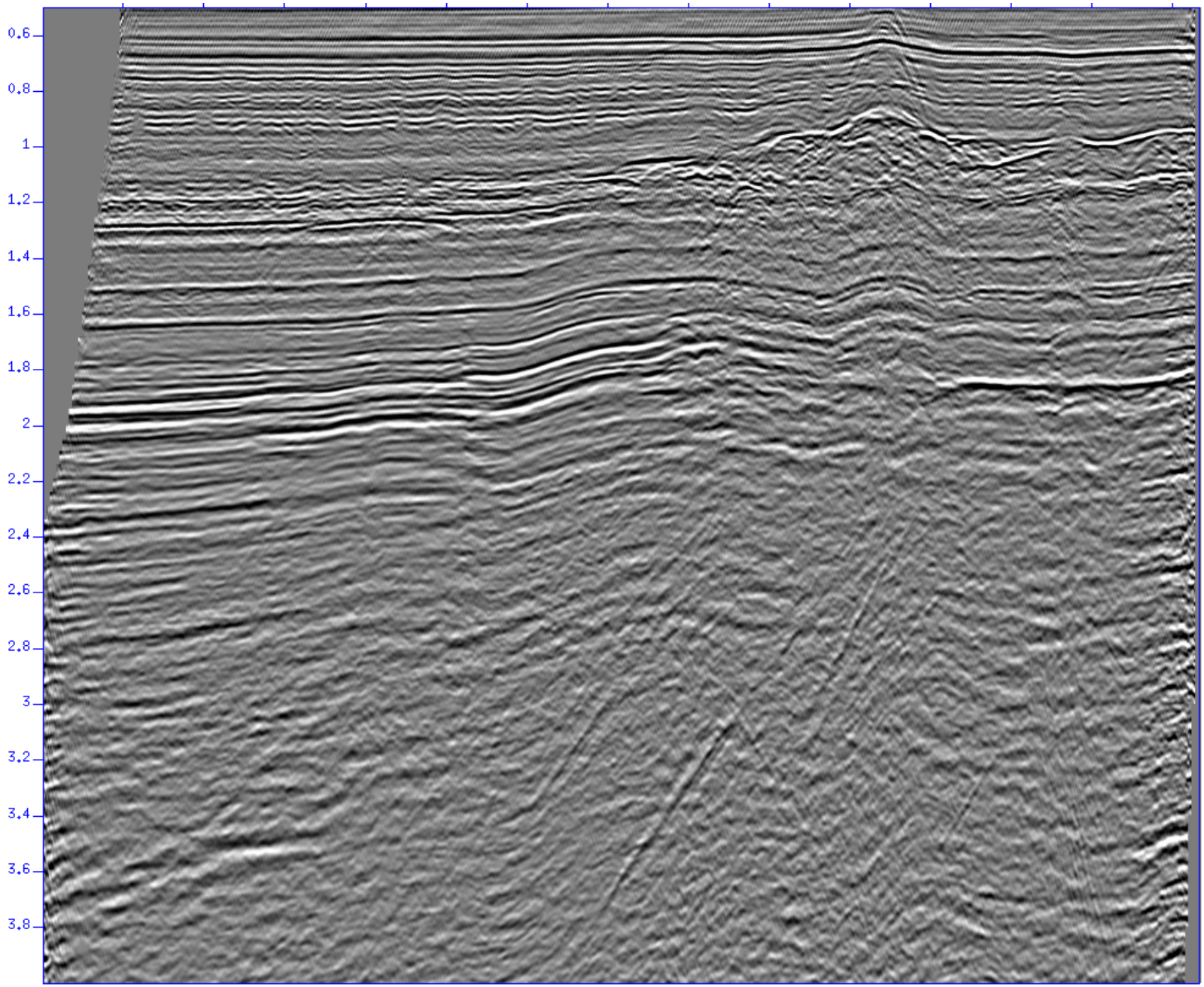
Stack: YOL00427 – New Velocities



Stack: YOL00493 – Old Velocities



Stack: YOL00493 – New Velocities



DownUnder GeoSolutions

Radon Testing Report

3rd August 2009

Origin Energy Resources Ltd

Yolla 3D Marine Seismic Survey Reprocessing

Radon Tests

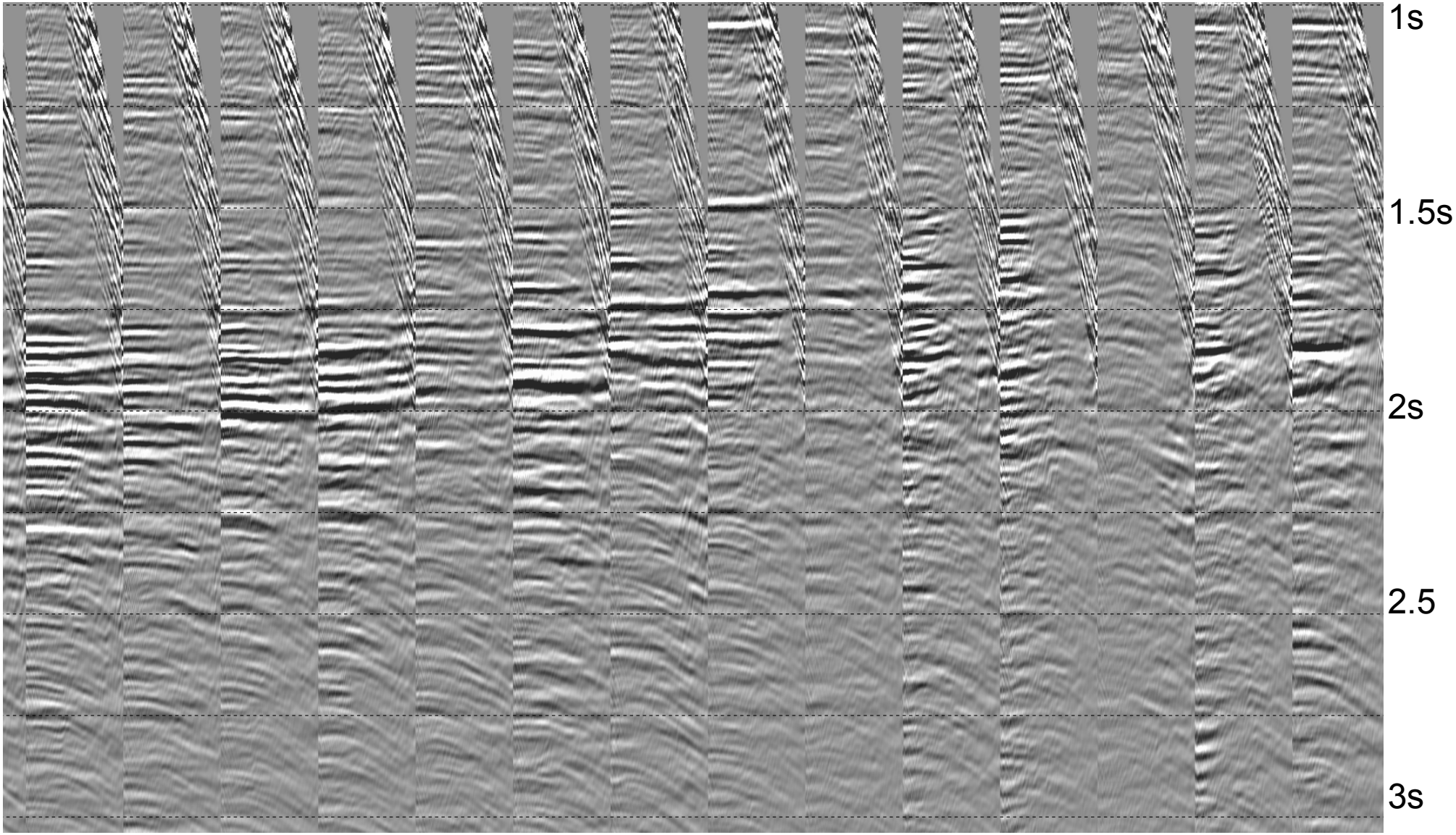
Radon demultiple tests were performed for the two test lines. The gathers were nmod with the re-picked velocity functions.

Tests include the following moveouts mutes:

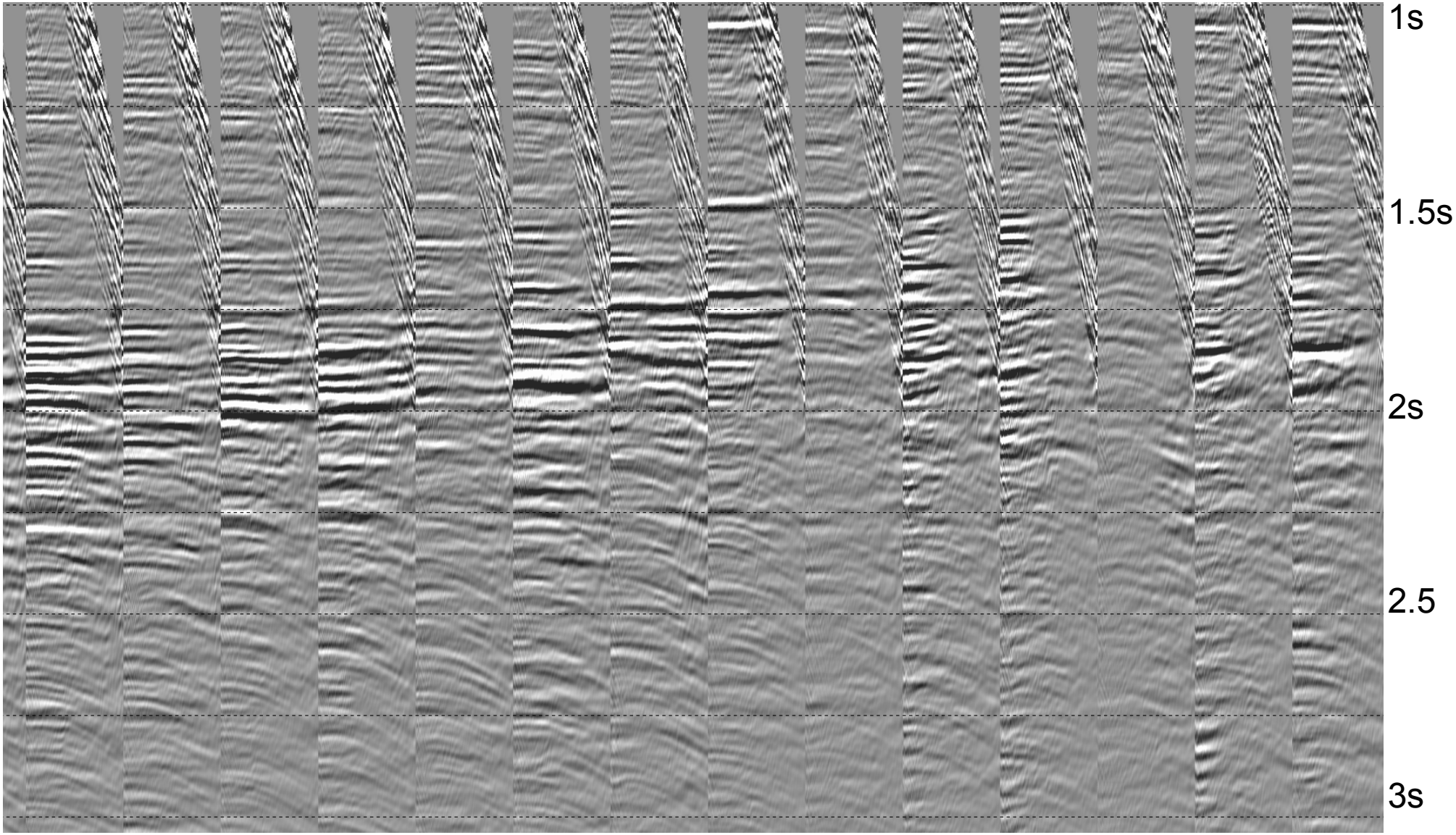
- 100ms, 150ms and 200ms at the far offset (~3100m).

The results of these test are shown below in both the the CMP and stack domains.

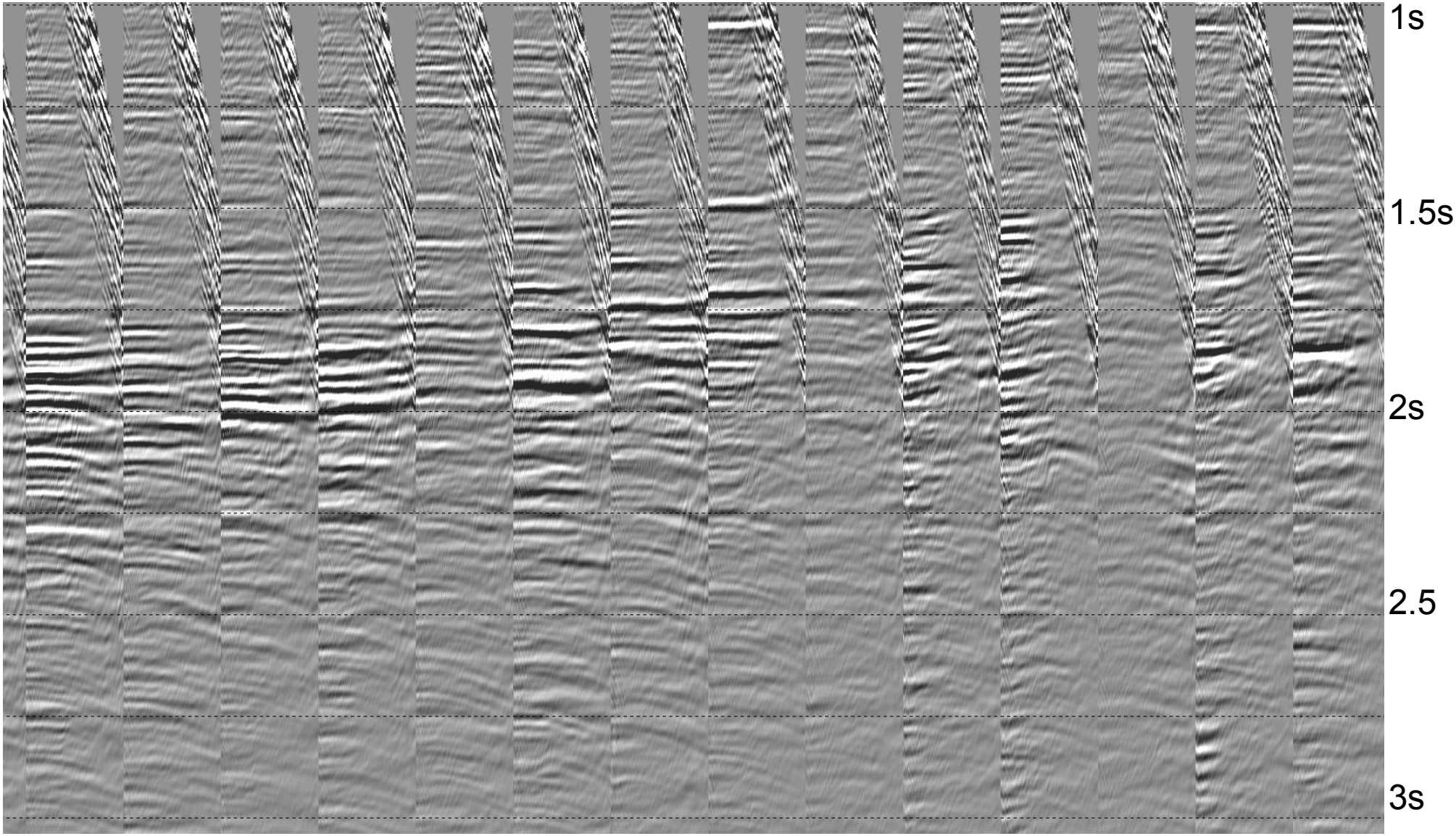
YOL00493 – Radon mute of 200ms at 3100m



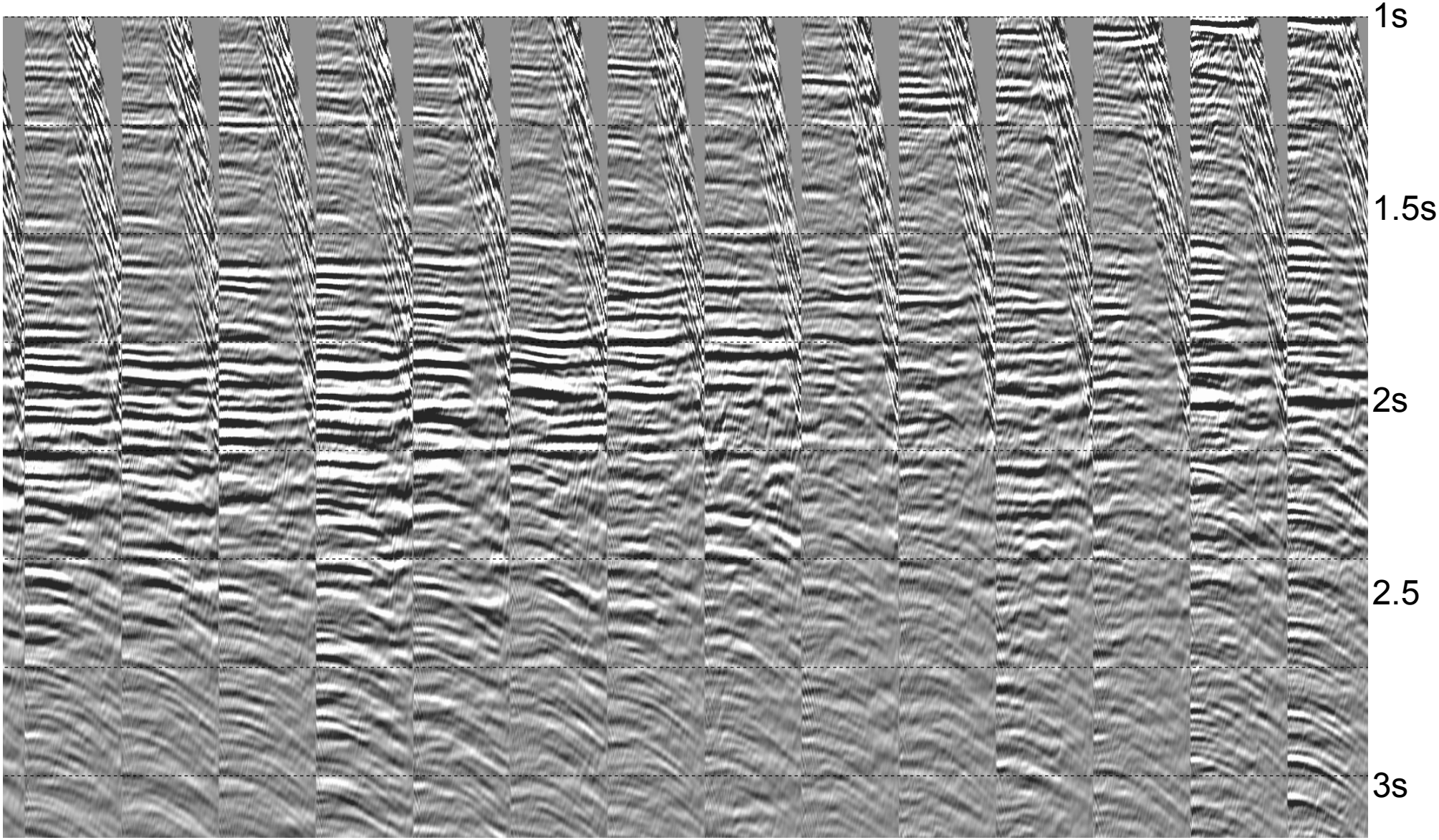
YOL00493 – Radon mute of 150ms at 3100m



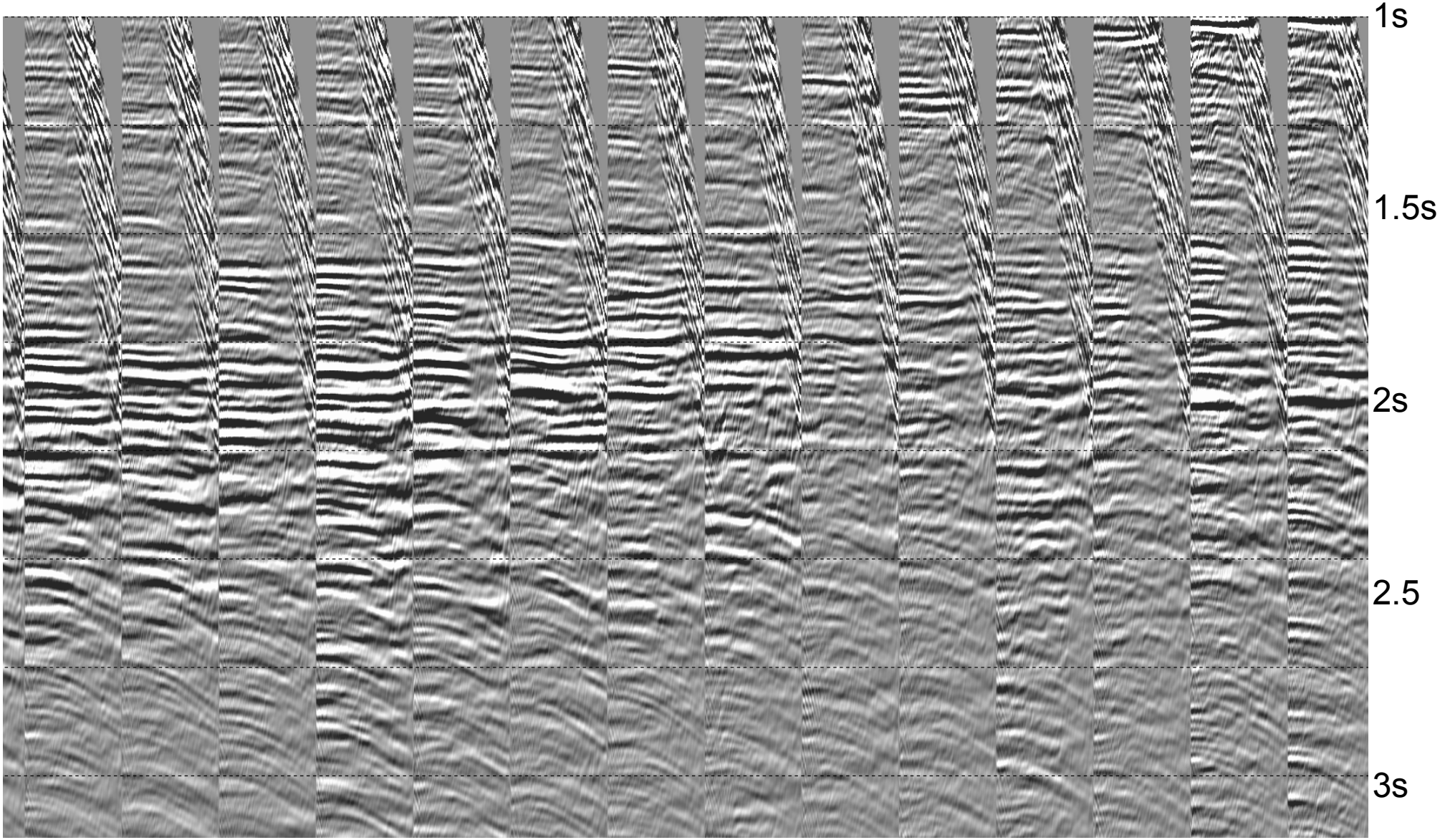
YOL00493 – Radon mute of 100ms at 3100m



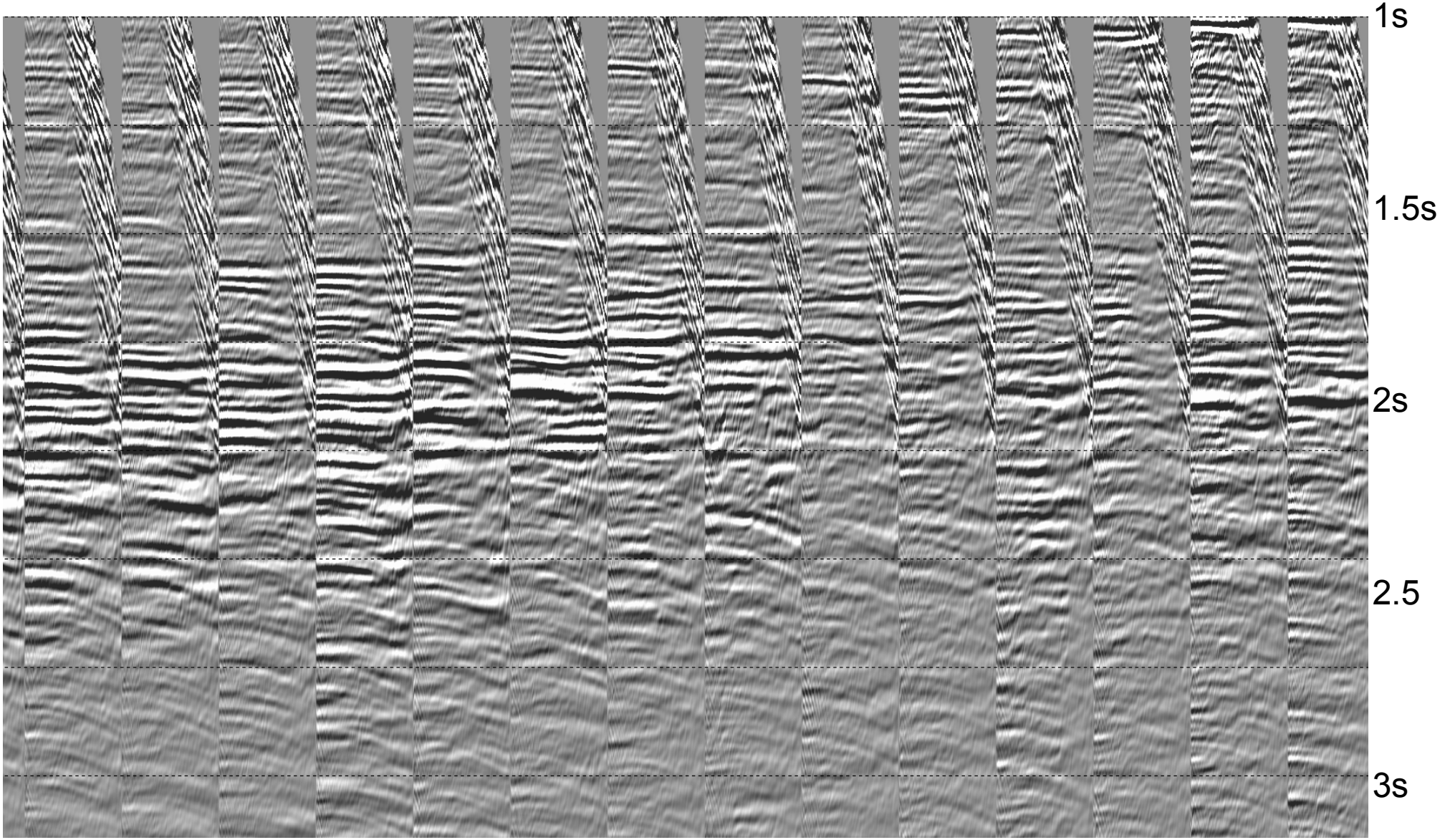
YOL00427 – Radon mute of 200ms at 3300m



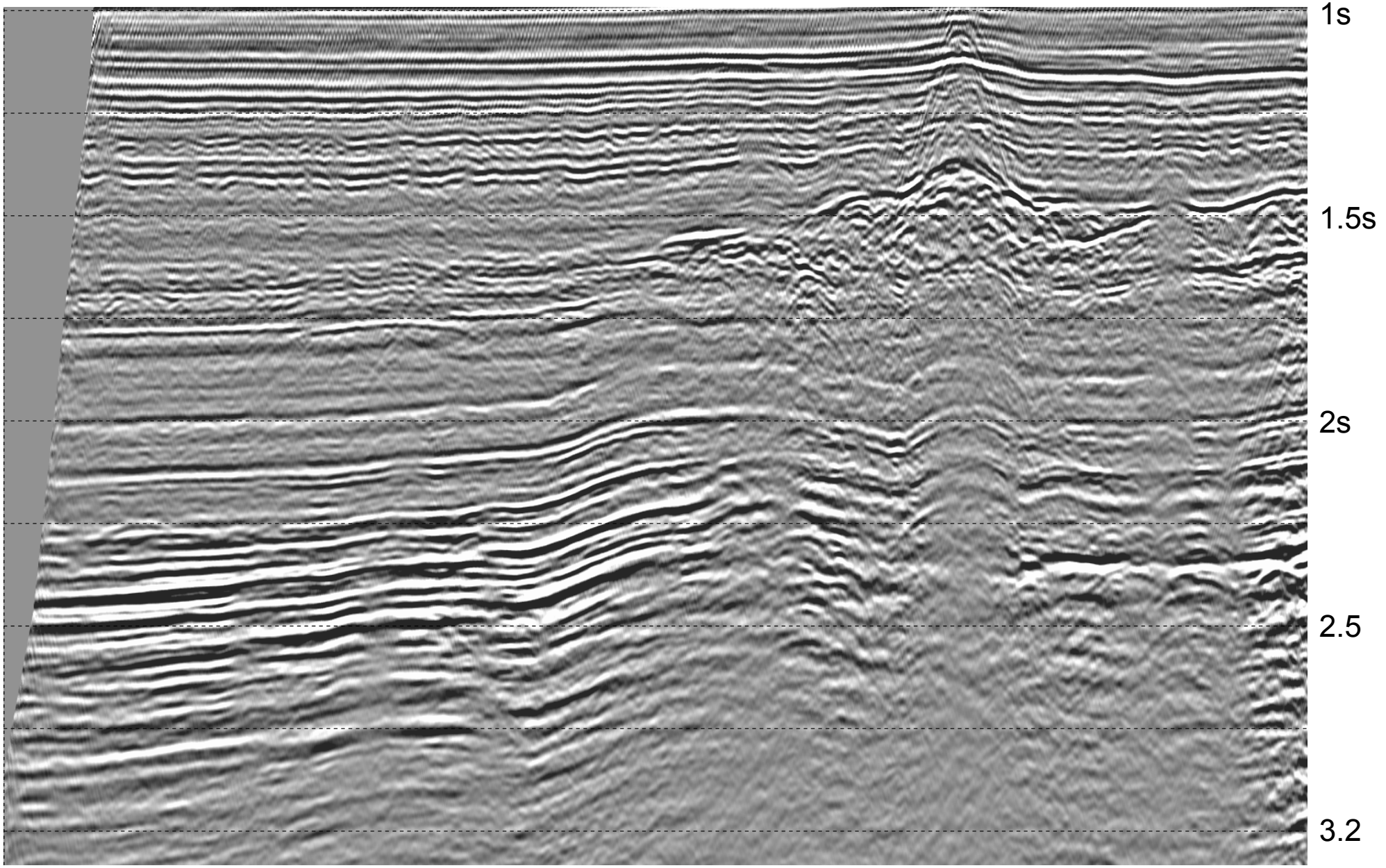
YOL00427 – Radon mute of 150ms at 3100m



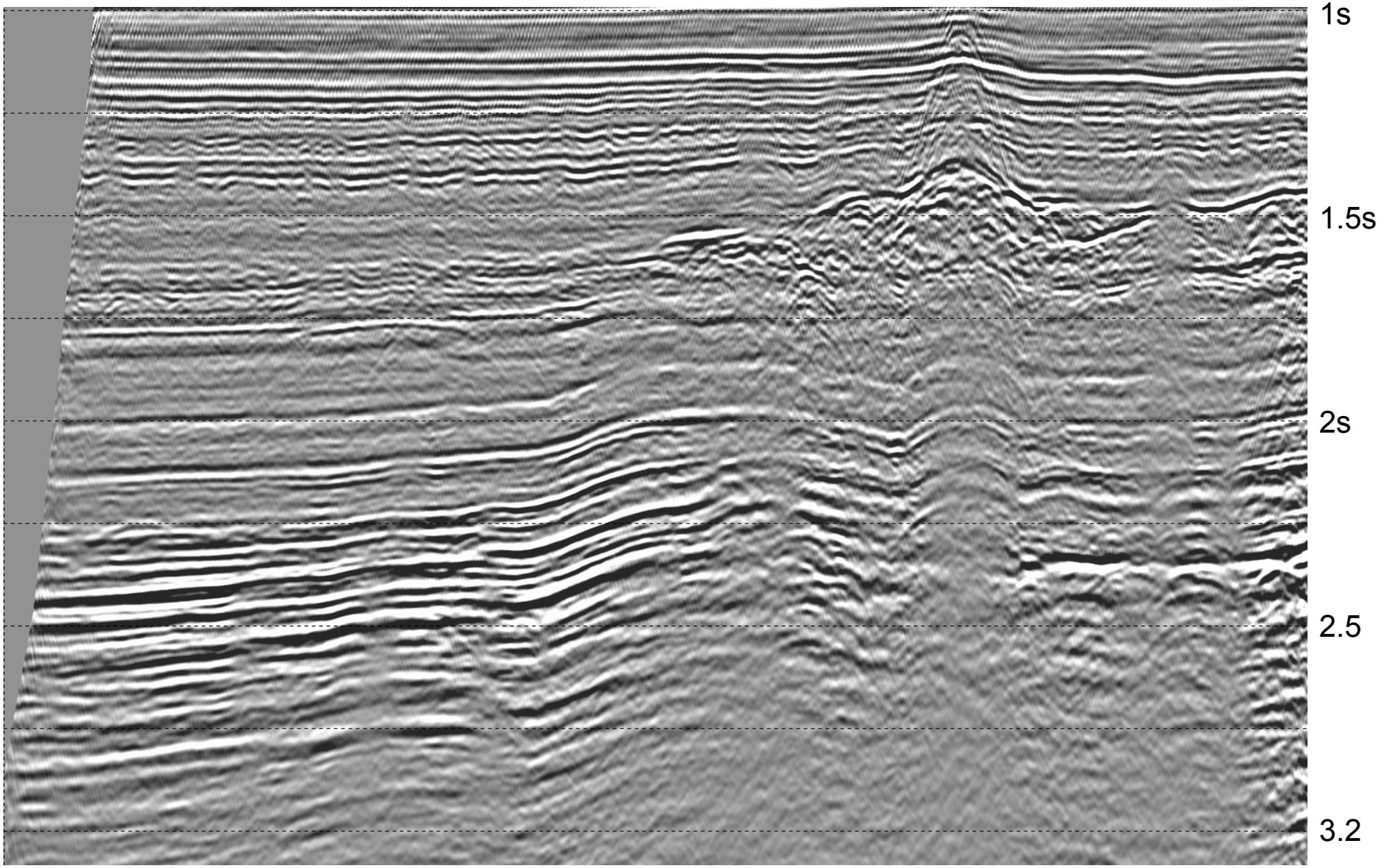
YOL00427 – Radon mute of 100ms at 3100m



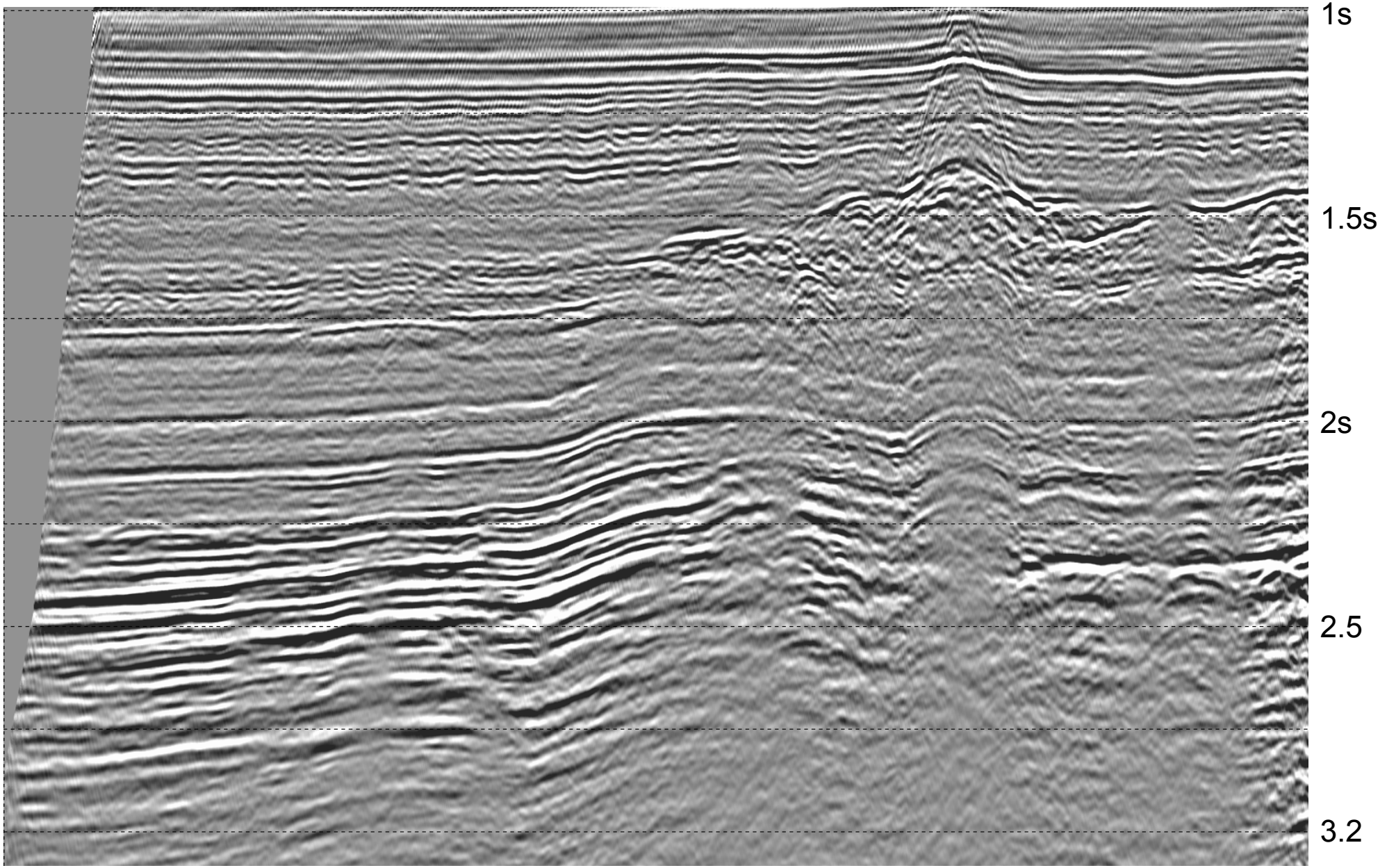
YOL00493 – Radon mute of 200ms at 3100m



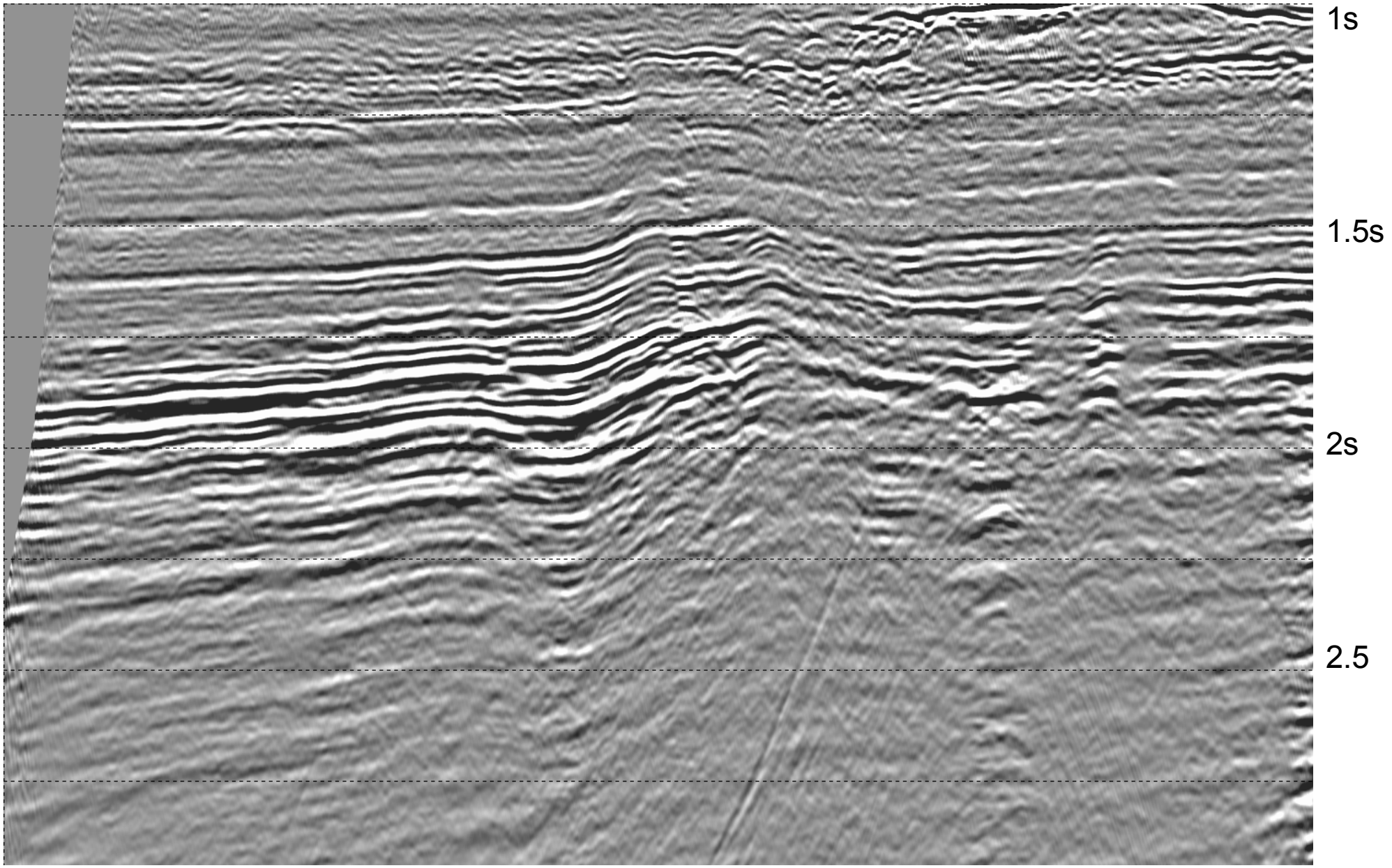
YOL00493 – Radon mute of 150ms at 3100m



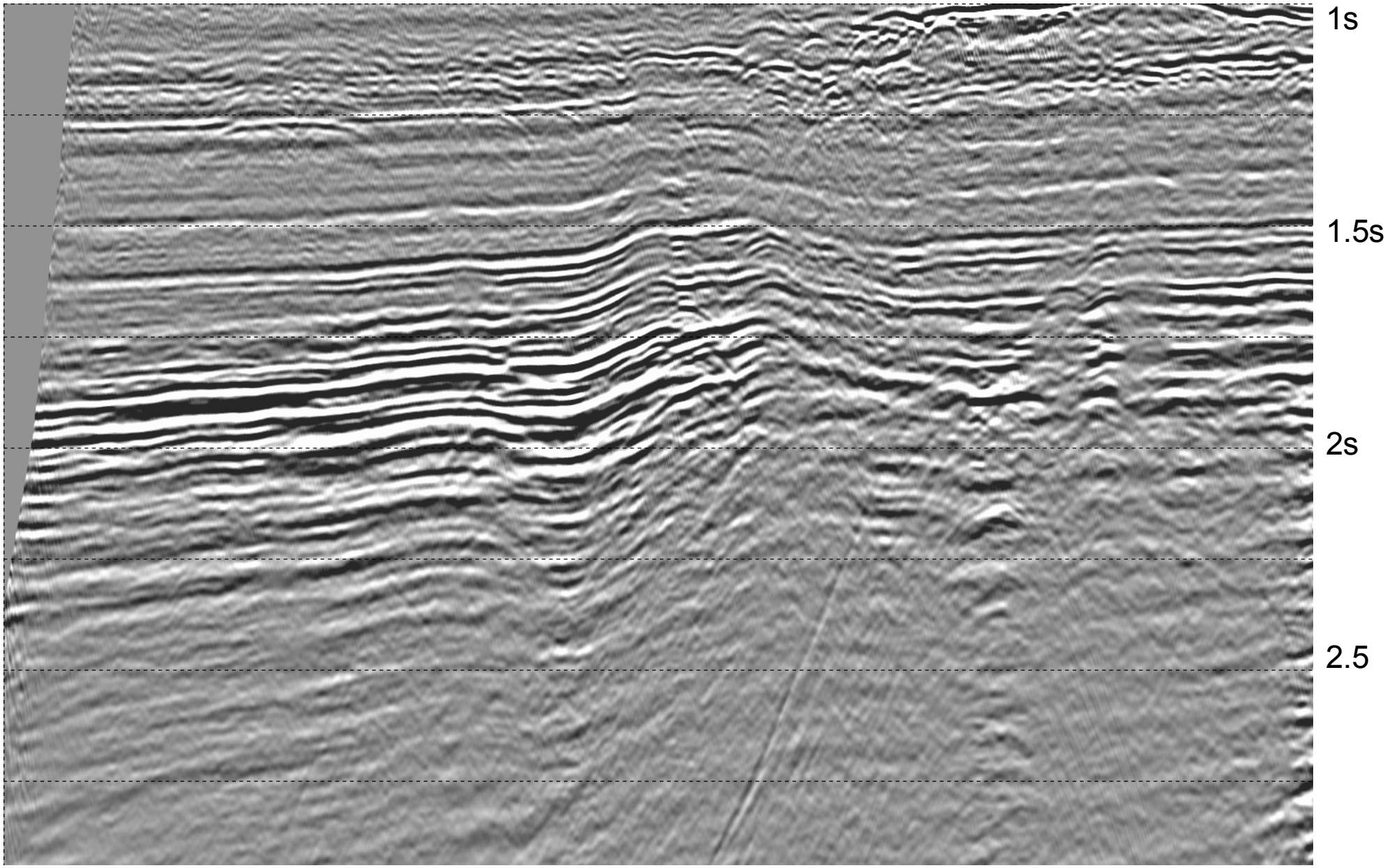
YOL00493 – Radon mute of 100ms at 3100m



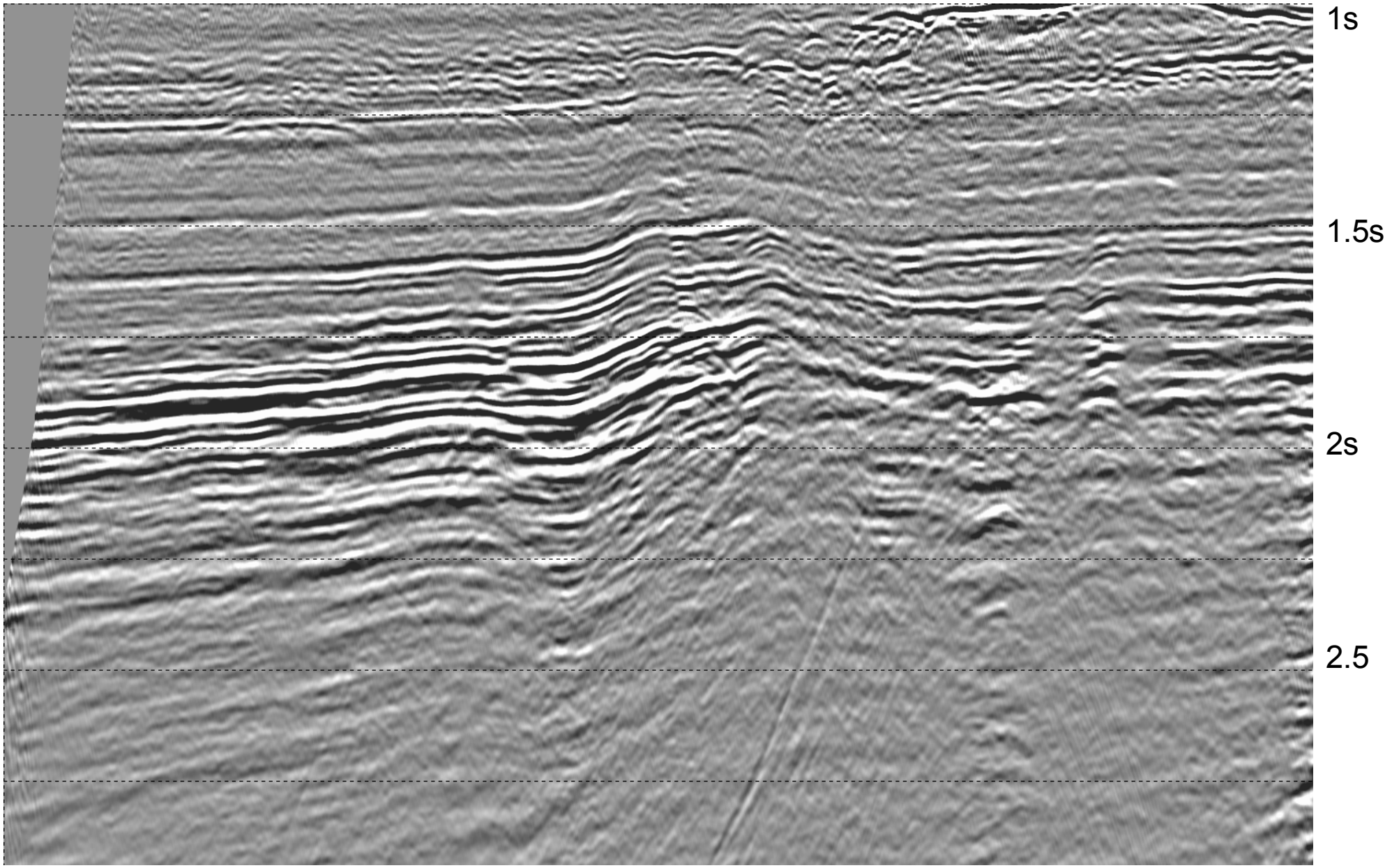
YOL00427 – Radon mute of 200ms at 3100m



YOL00427 – Radon mute of 150ms at 3100m



YOL00427 – Radon mute of 100ms at 3100m



DownUnder GeoSolutions

Radon Parameter Testing Update

4th August 2009

Origin Energy Resources Ltd

Yolla 3D Marine Seismic Survey Reprocessing

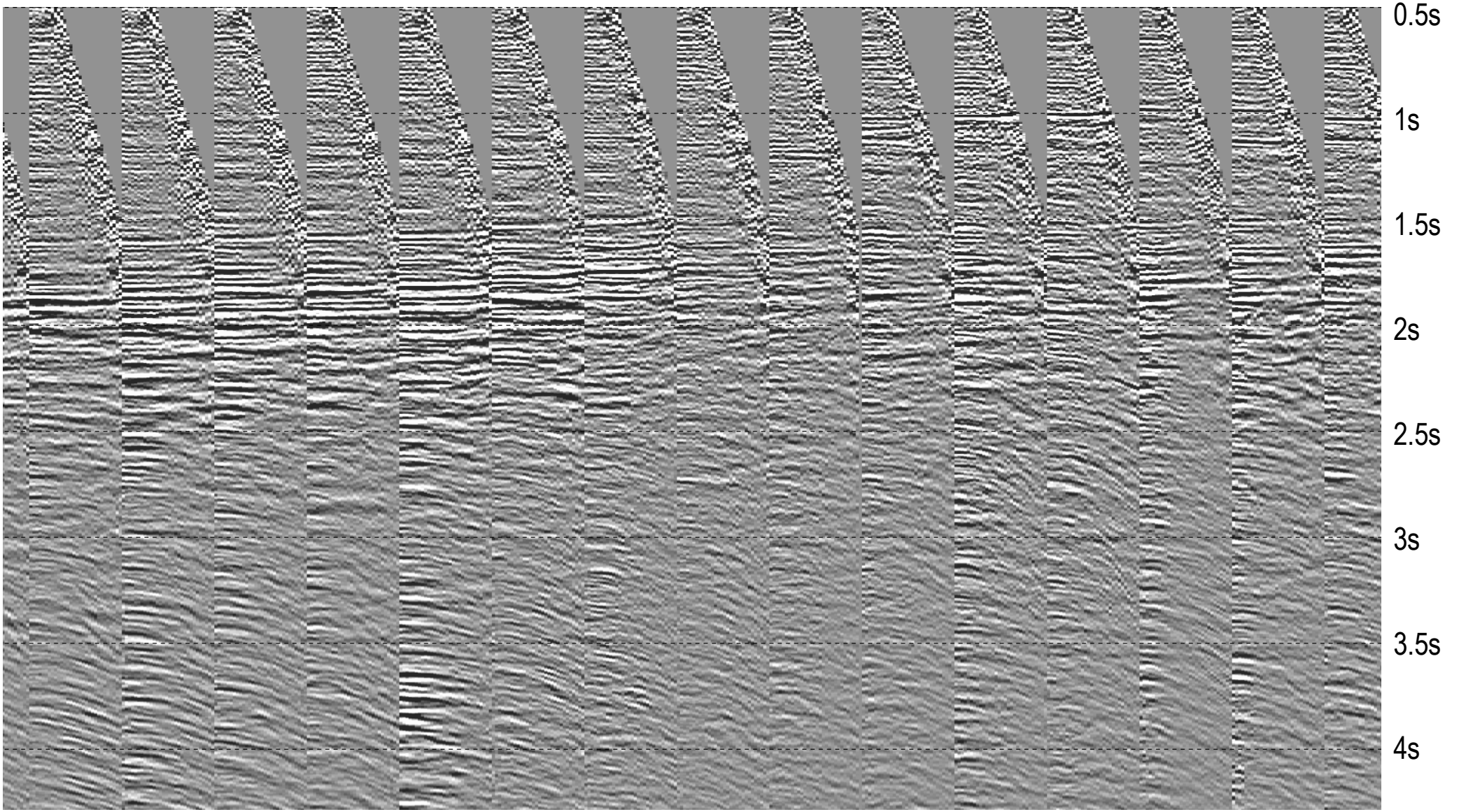
Radon Testing Update:

- This report contains the images requested by Origin on the 3rd of August. These include Pre/Post Radon difference plots in both the stack and gather domain and images of deeper sections.

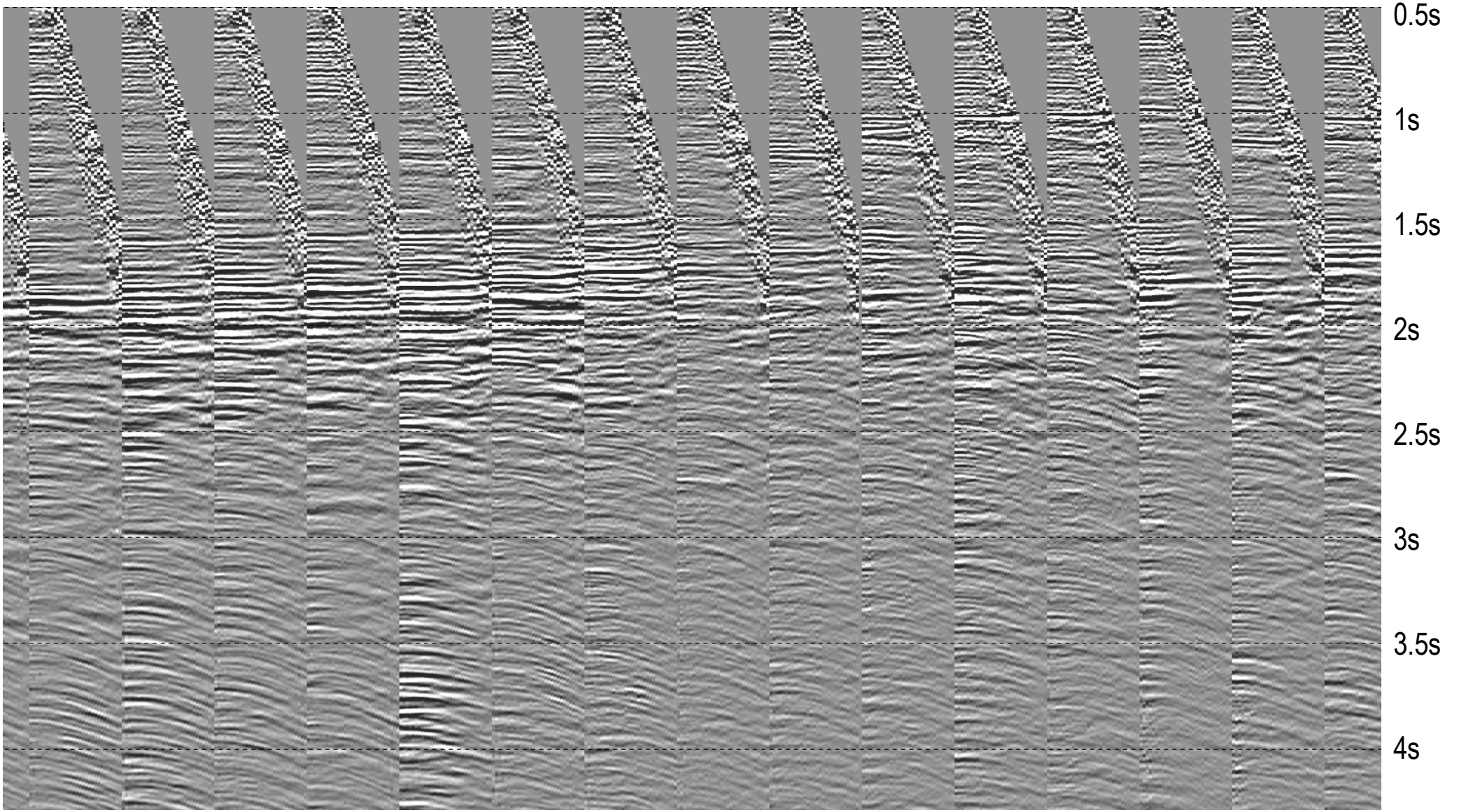
Radon Tests - YOL00427

Test Line YOL00427

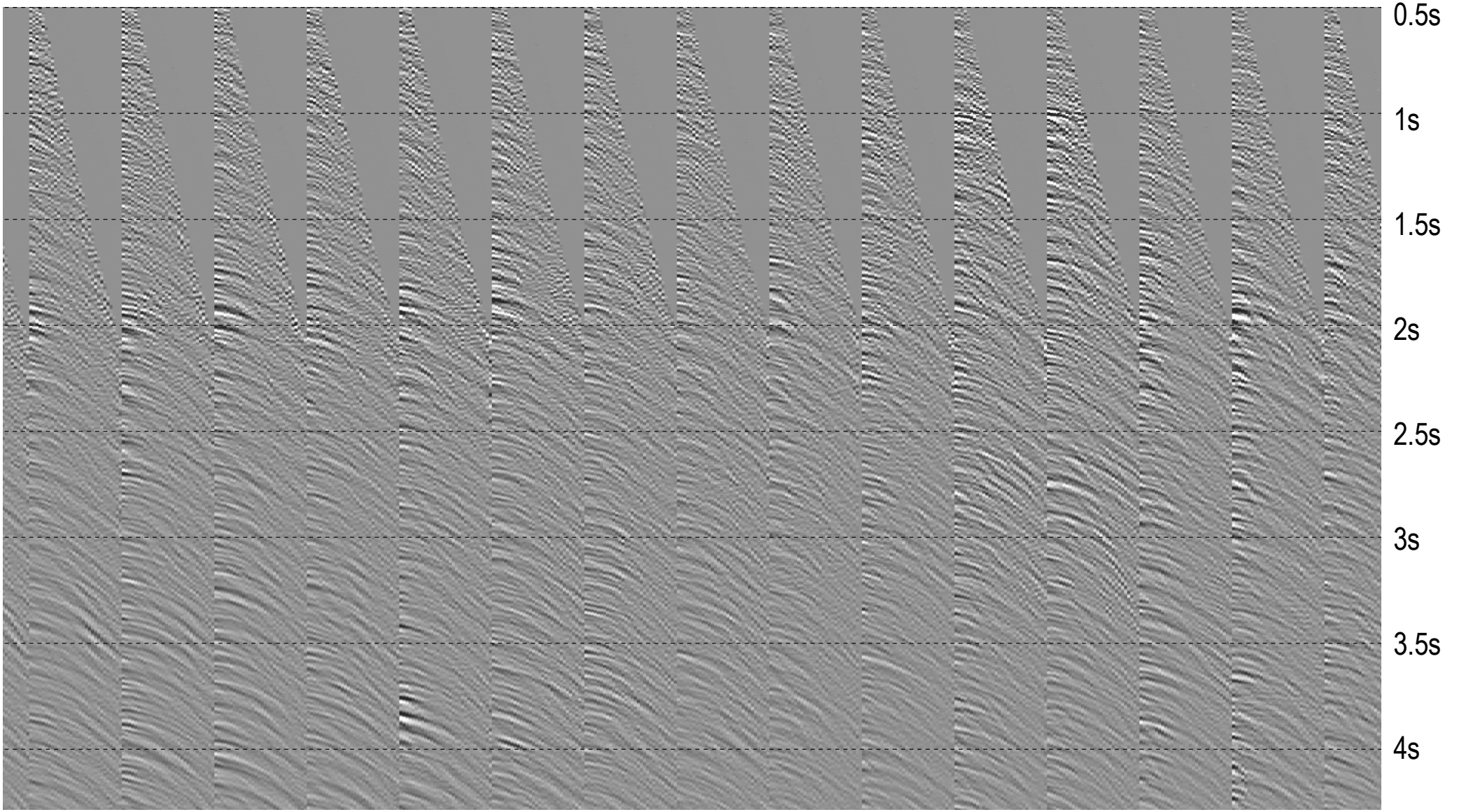
YOL00427 – Pre-Radon Gathers



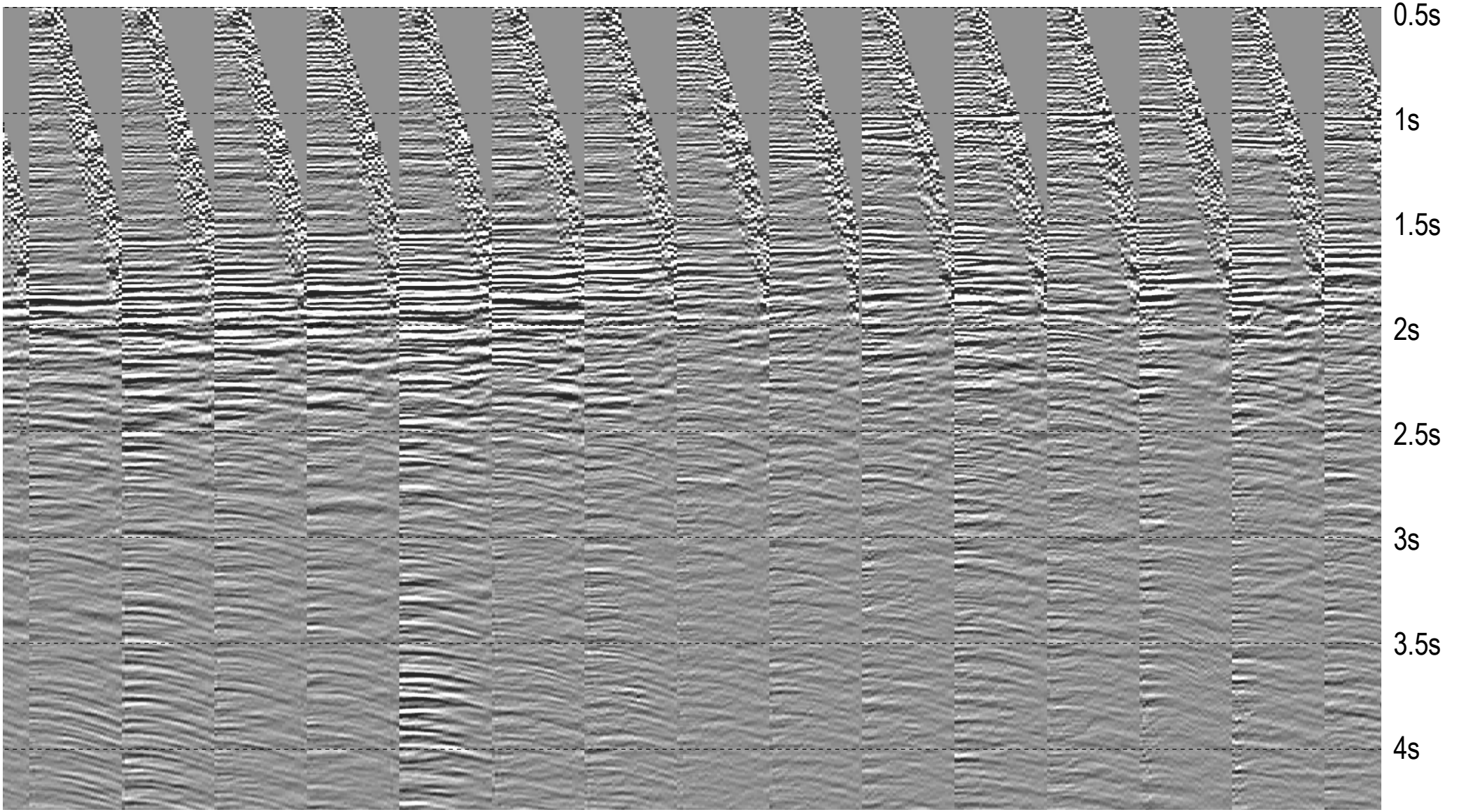
YOL00427 – Radon mute of 200ms at 3100m



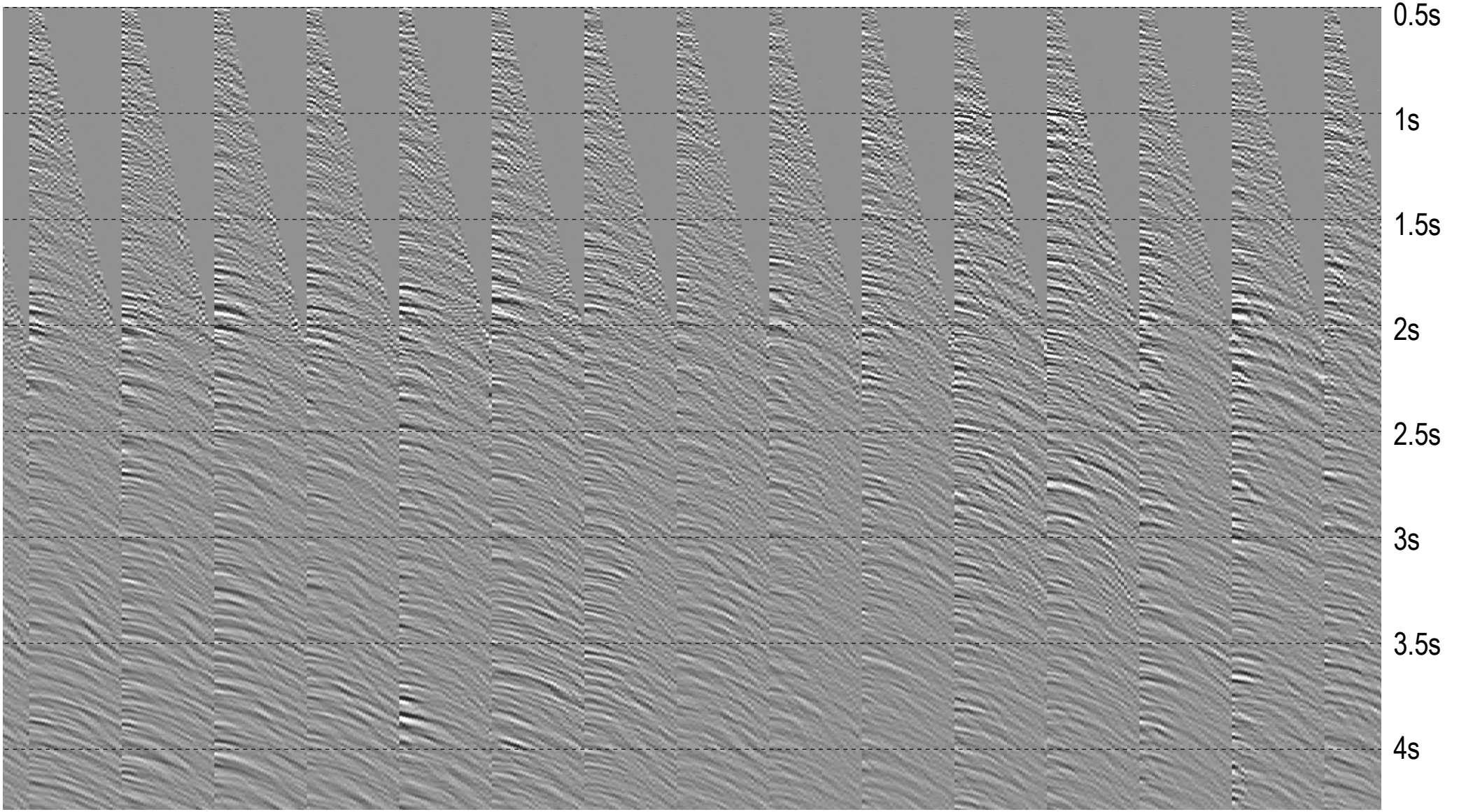
YOL00427 – Difference



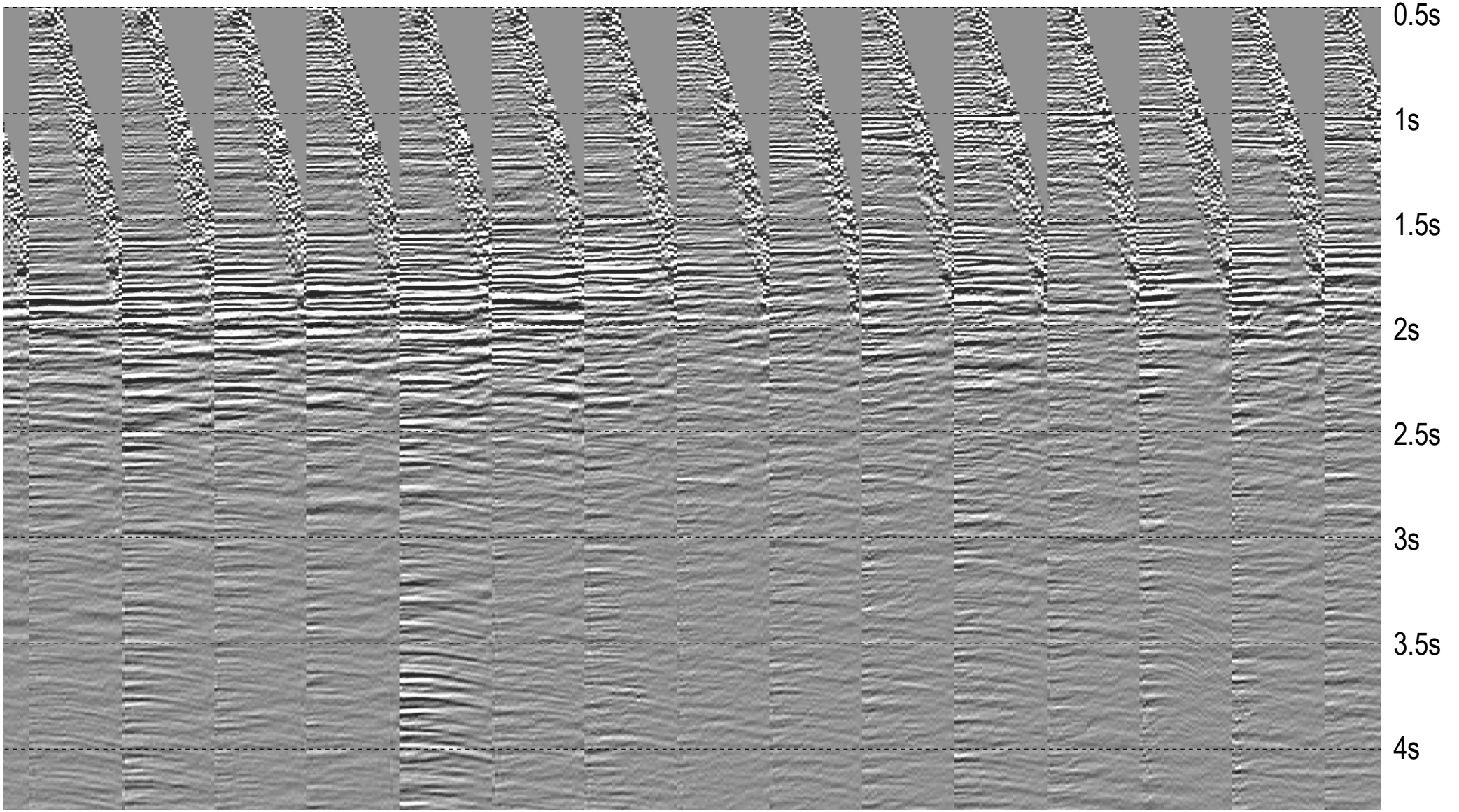
YOL00427 – Radon mute of 150ms at 3100m



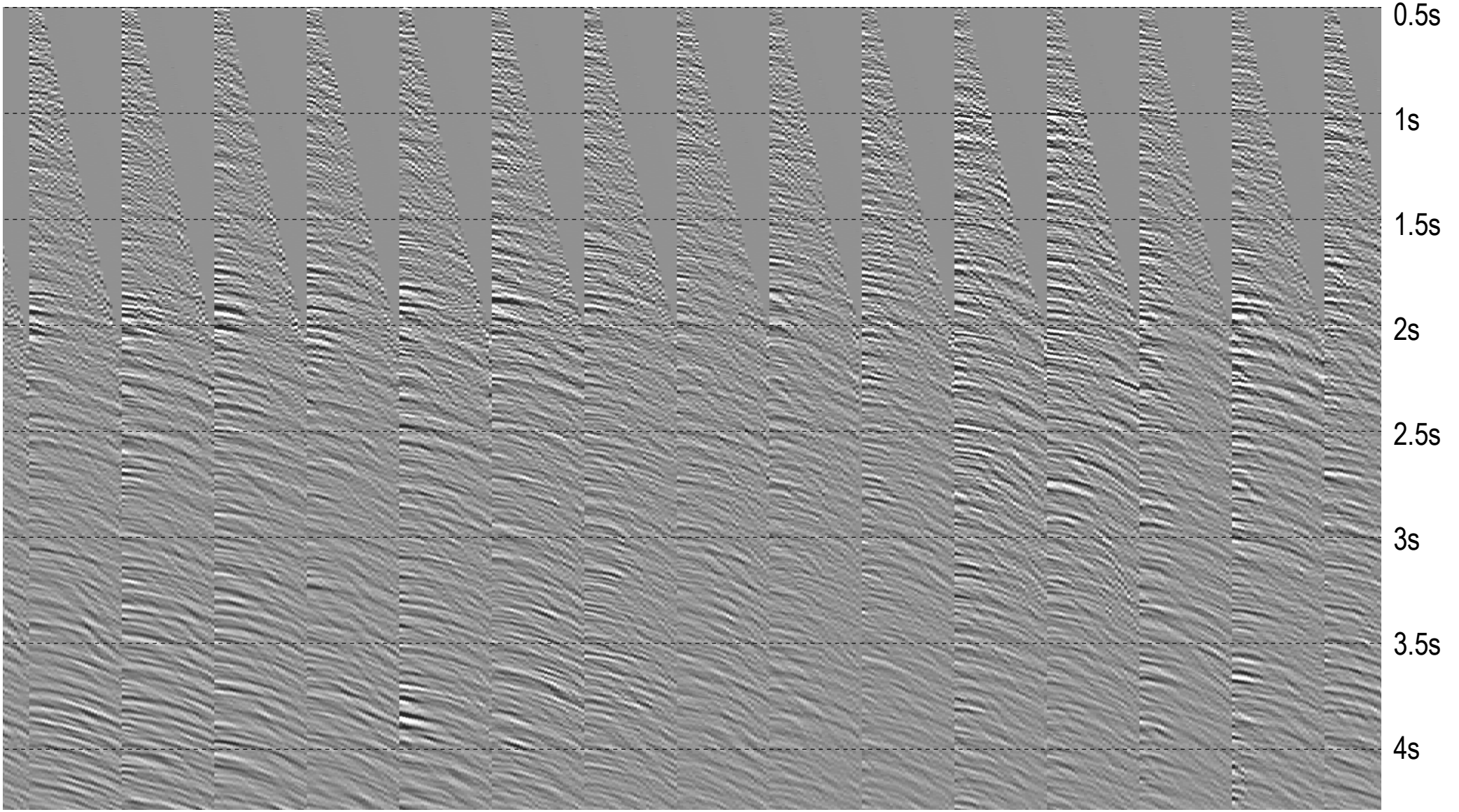
YOL00427 – Difference



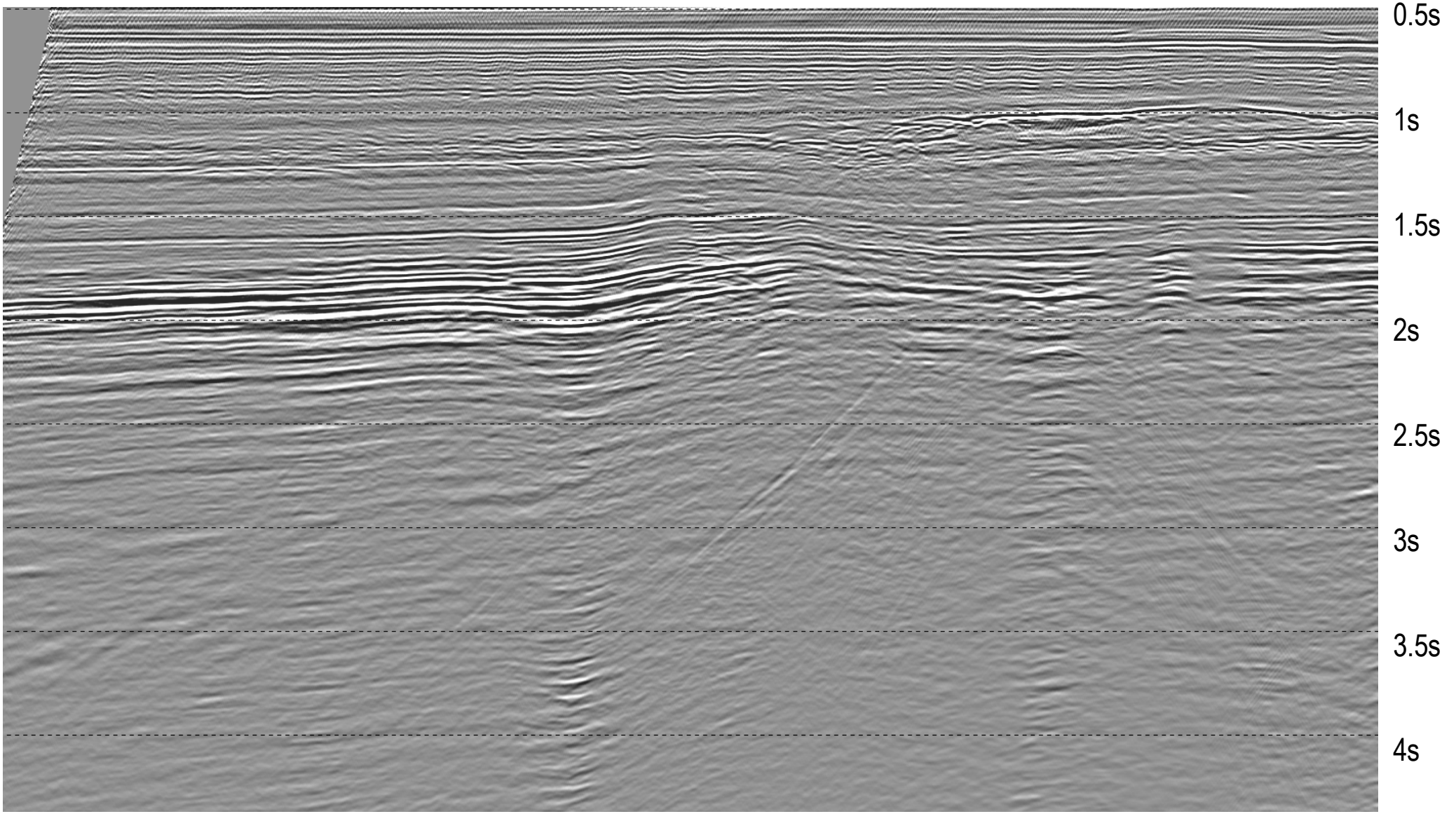
YOL00427 – Radon mute of 100ms at 3100m



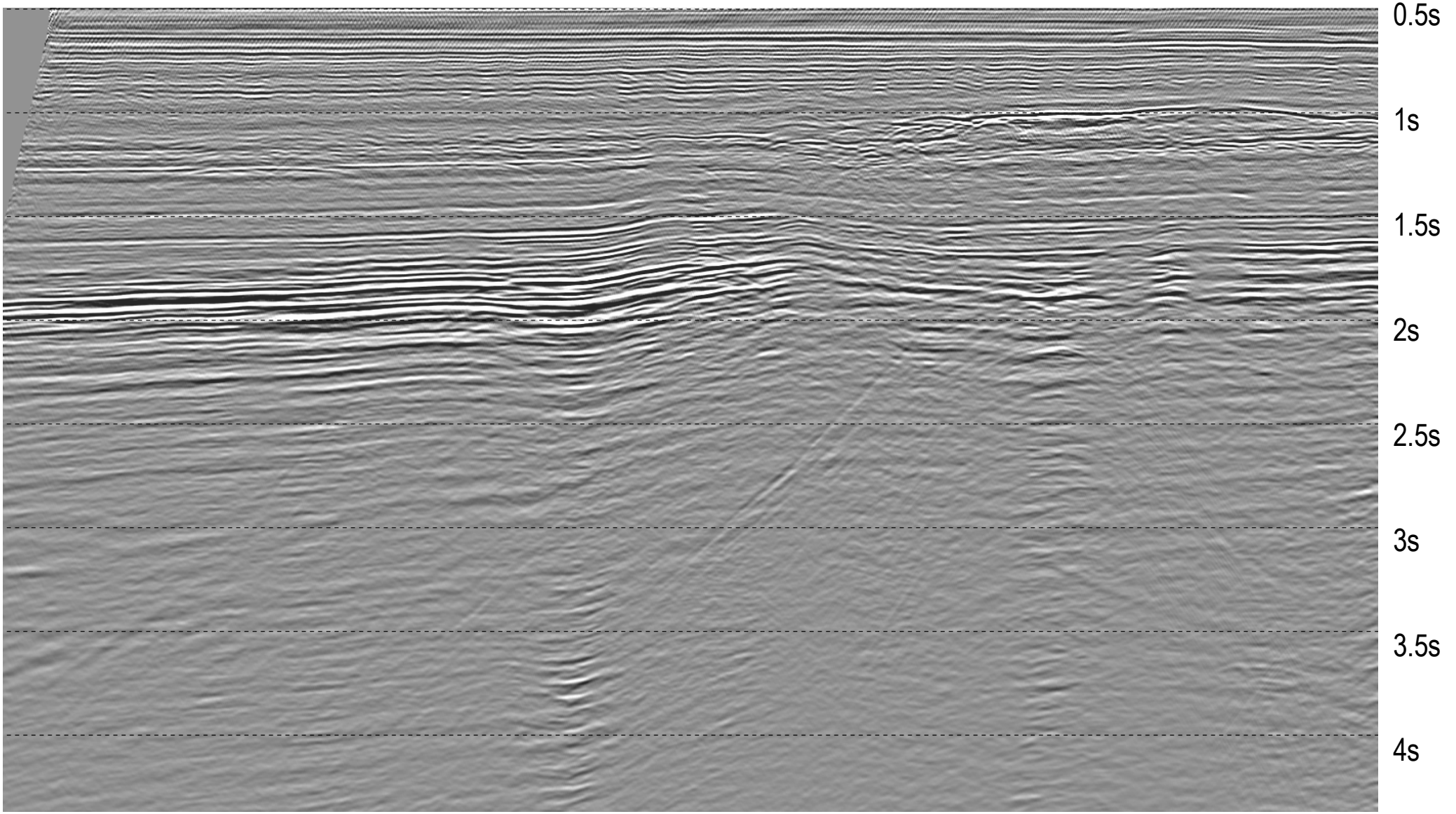
YOL00427 – Difference



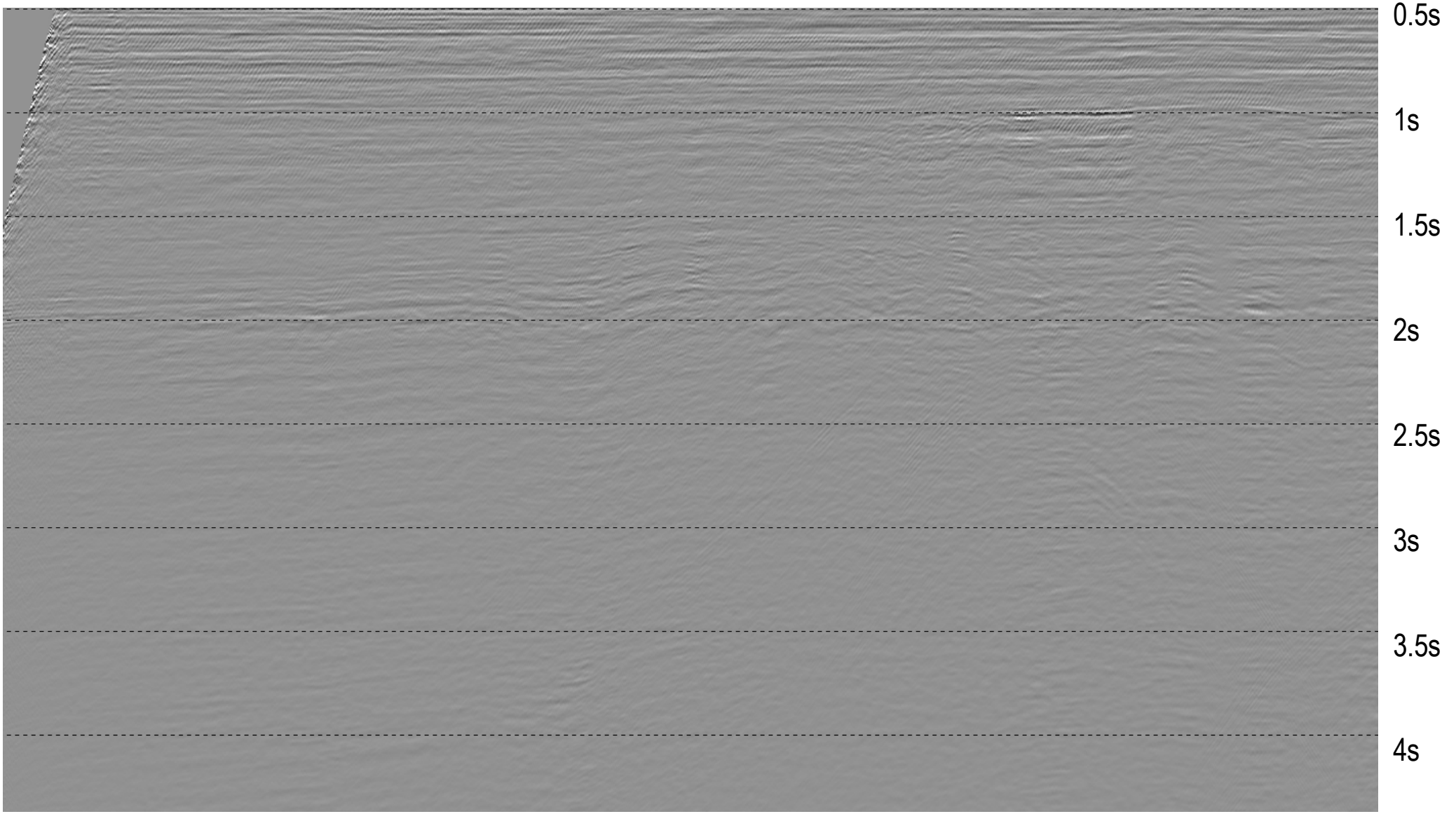
YOL00427 – Reference Stack



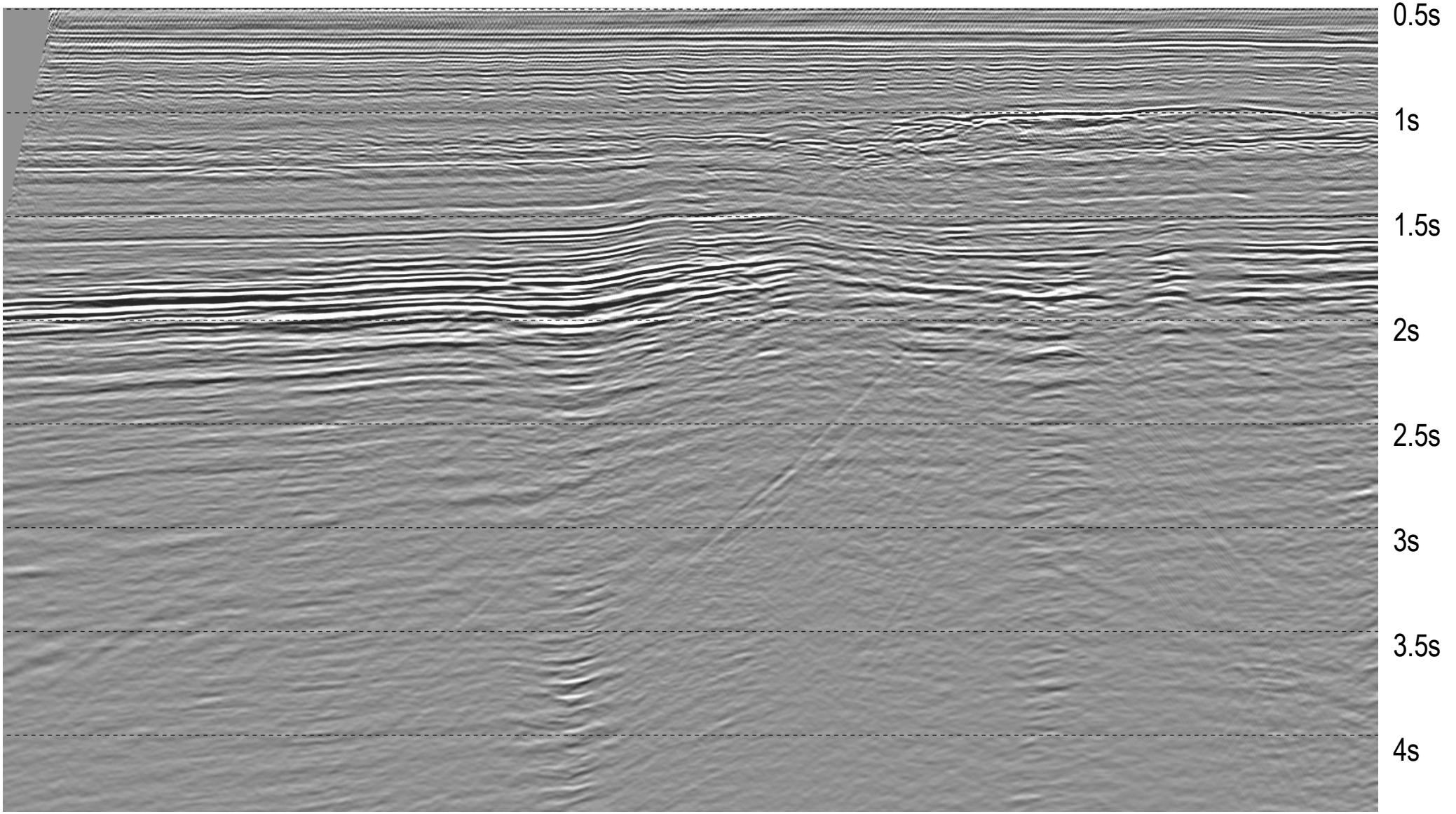
YOL00427 – Radon mute of 200ms at 3100m



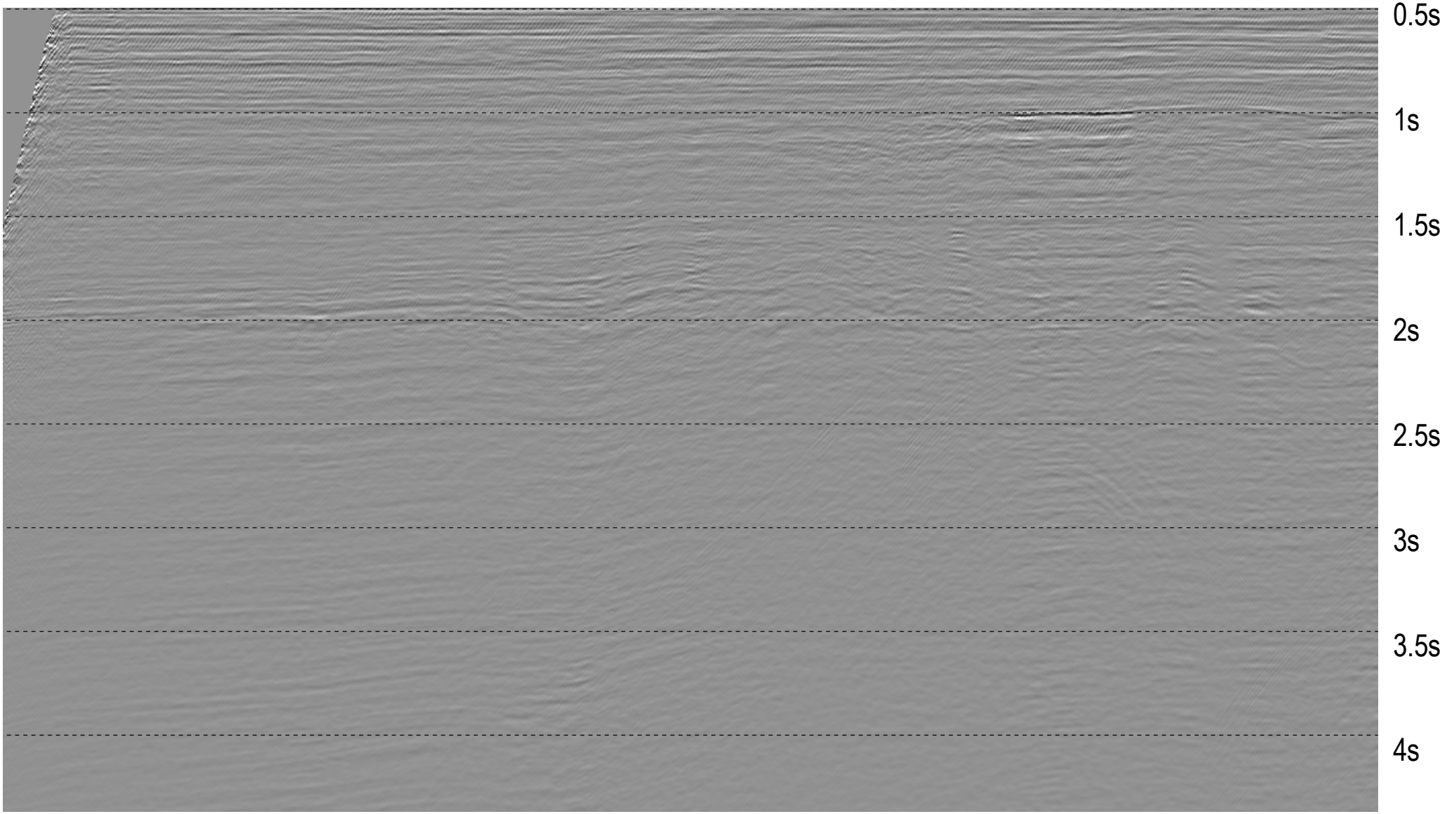
YOL00427 – Difference



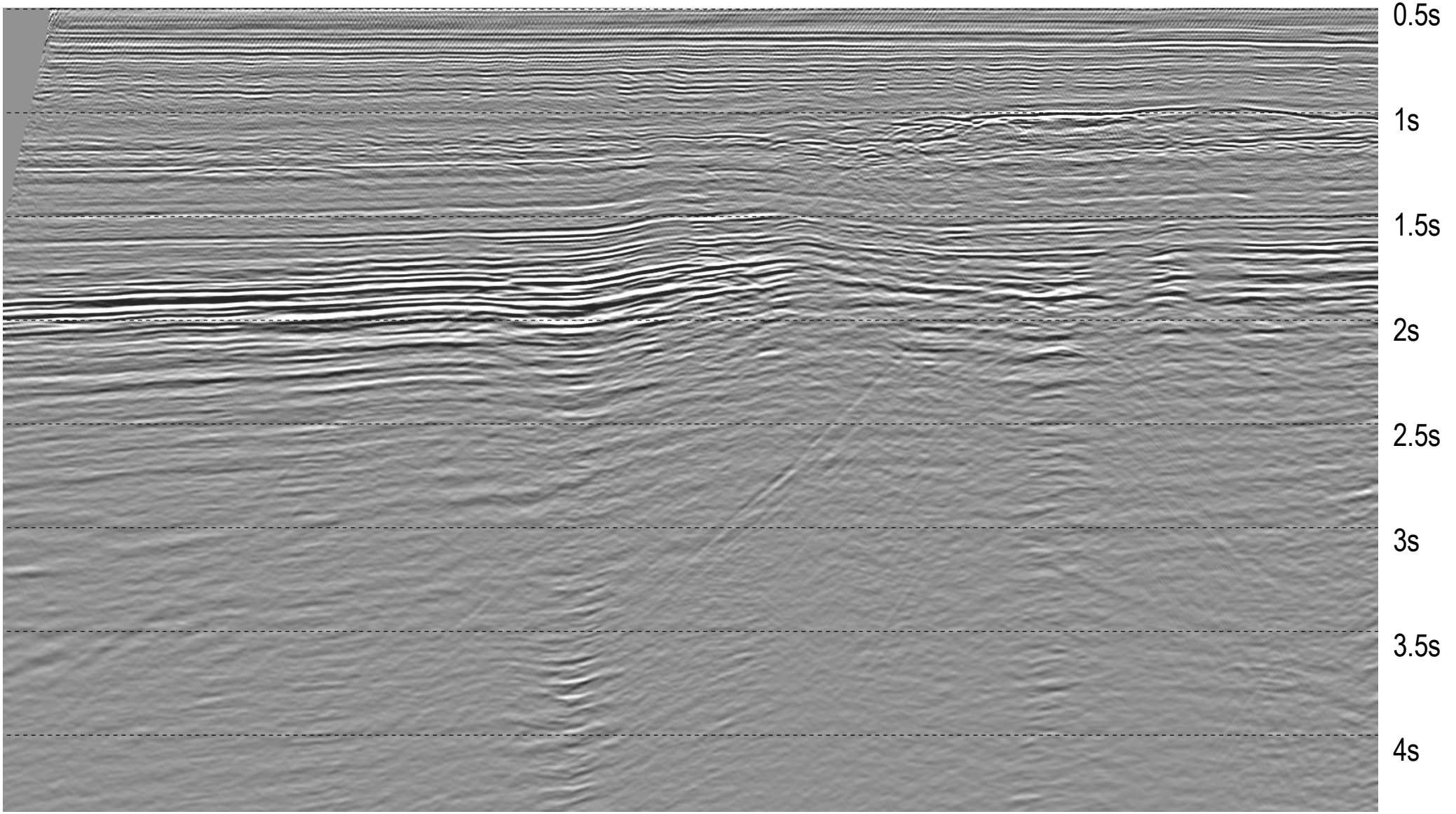
YOL00427 – Radon mute of 150ms at 3100m



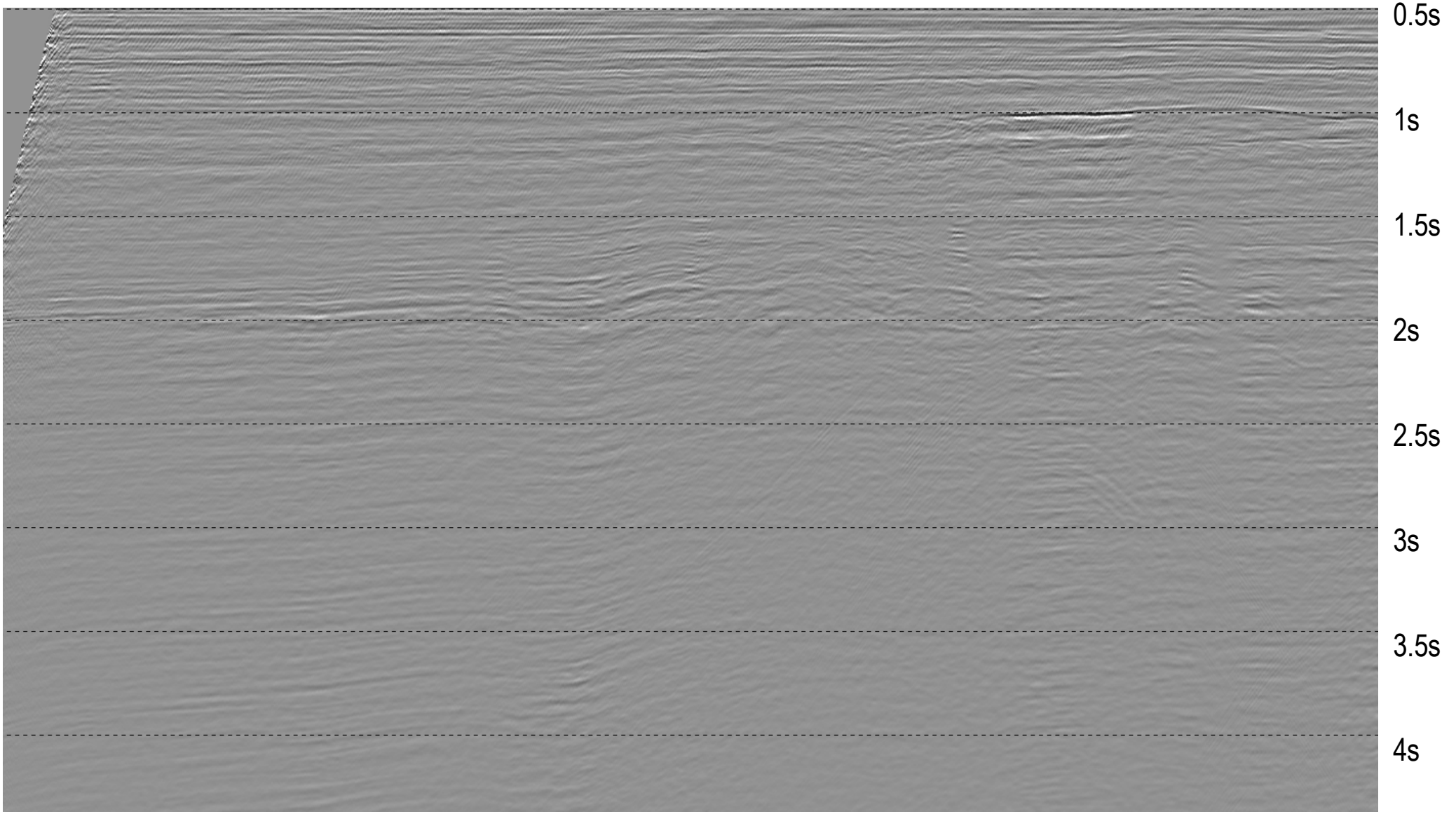
YOL00427 – Difference



YOL00427 – Radon mute of 100ms at 3100m



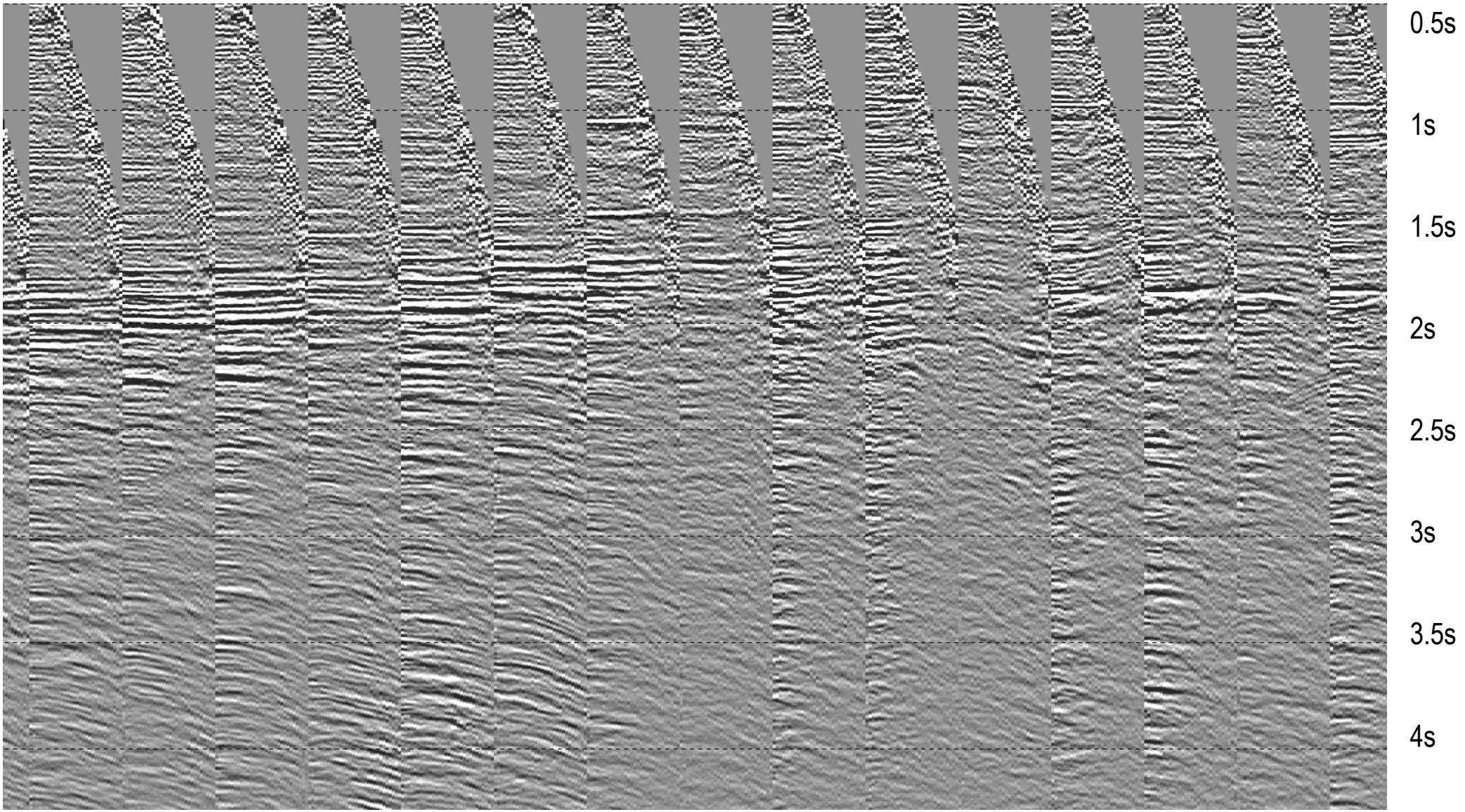
YOL00427 – Difference



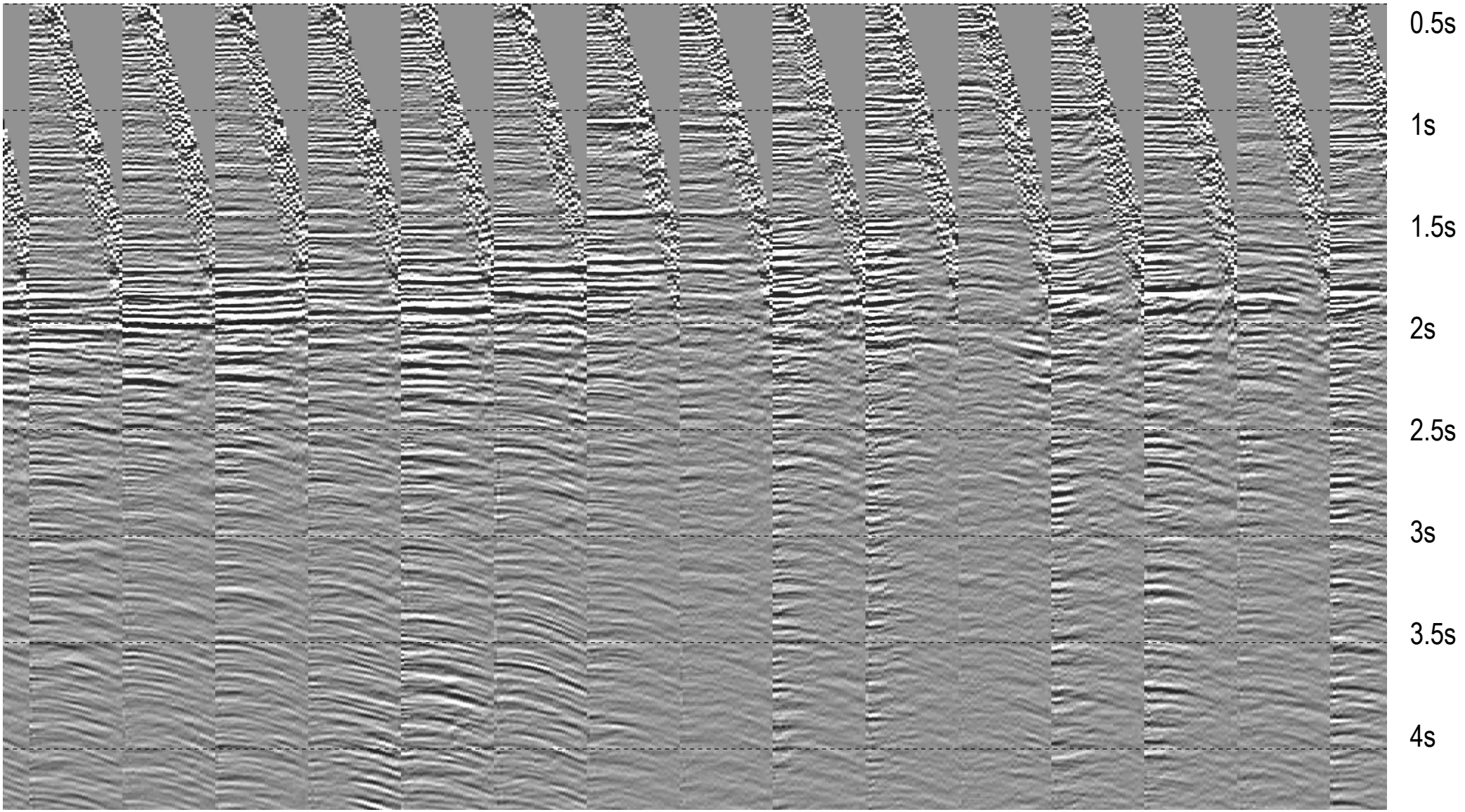
Radon Tests - YOL00493

Test Line YOL00493

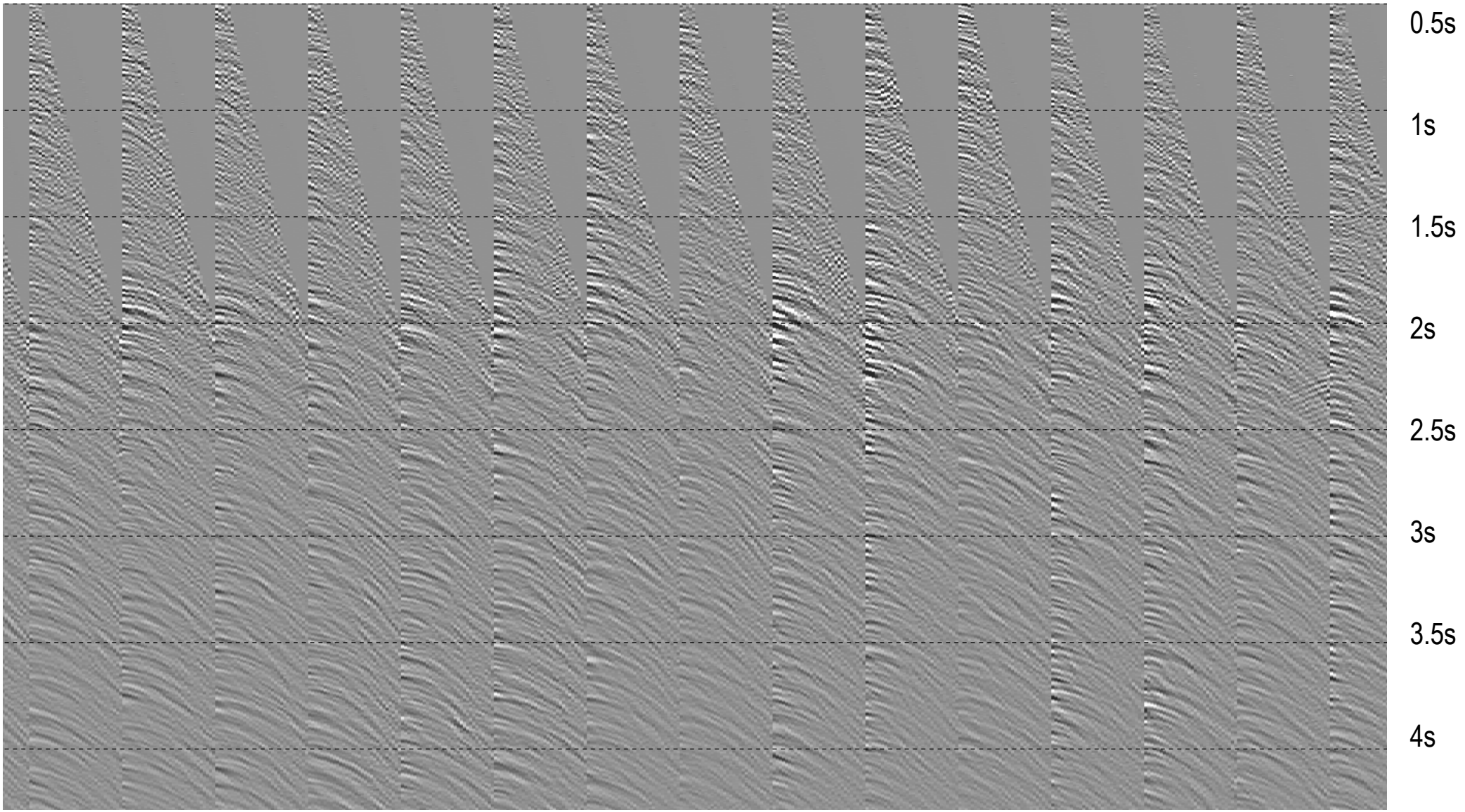
YOL00493 – Pre-Radon Gathers



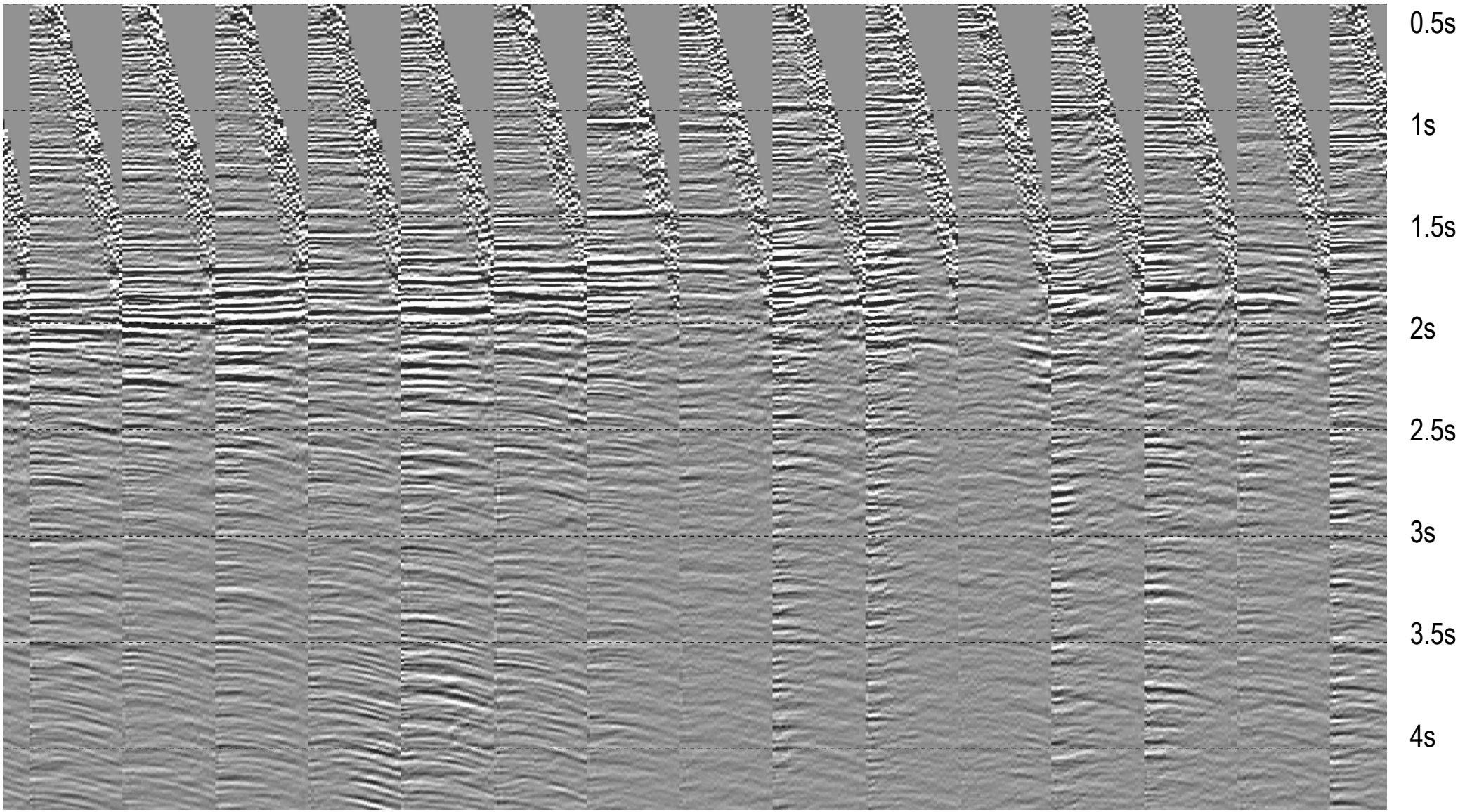
YOL00493 – Radon mute of 200ms at 3100m



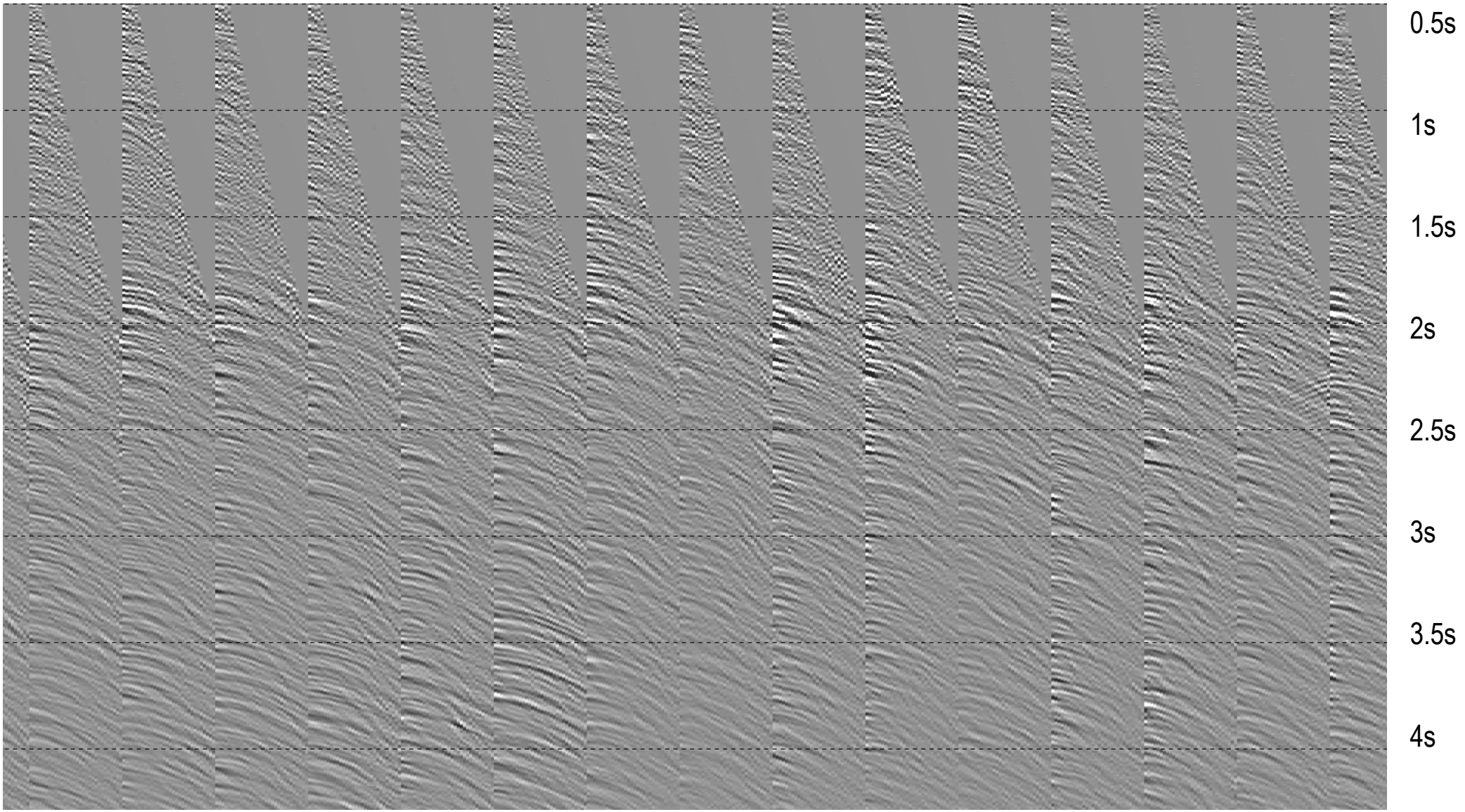
YOL00493 – Difference



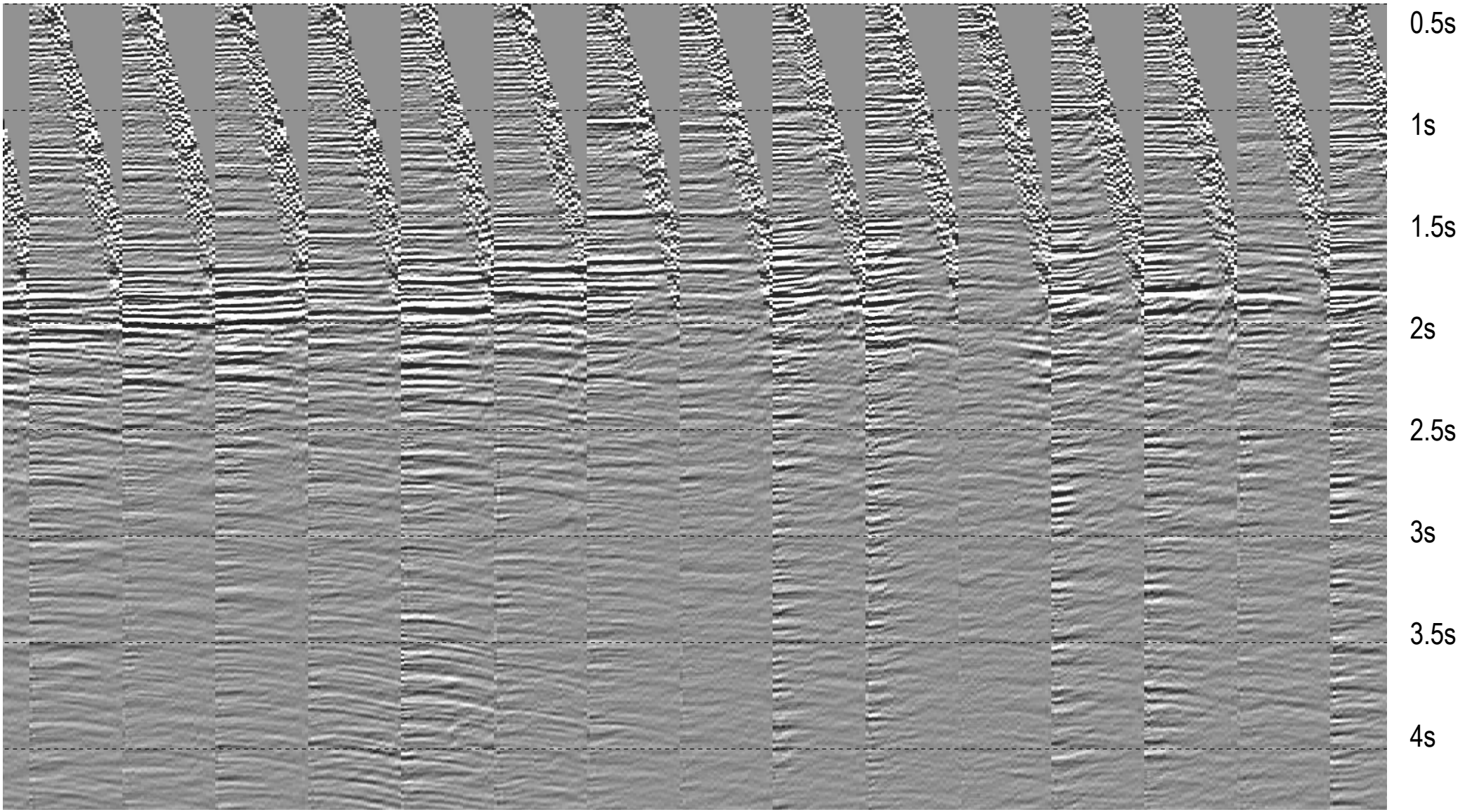
YOL00493 – Radon mute of 150ms at 3100m



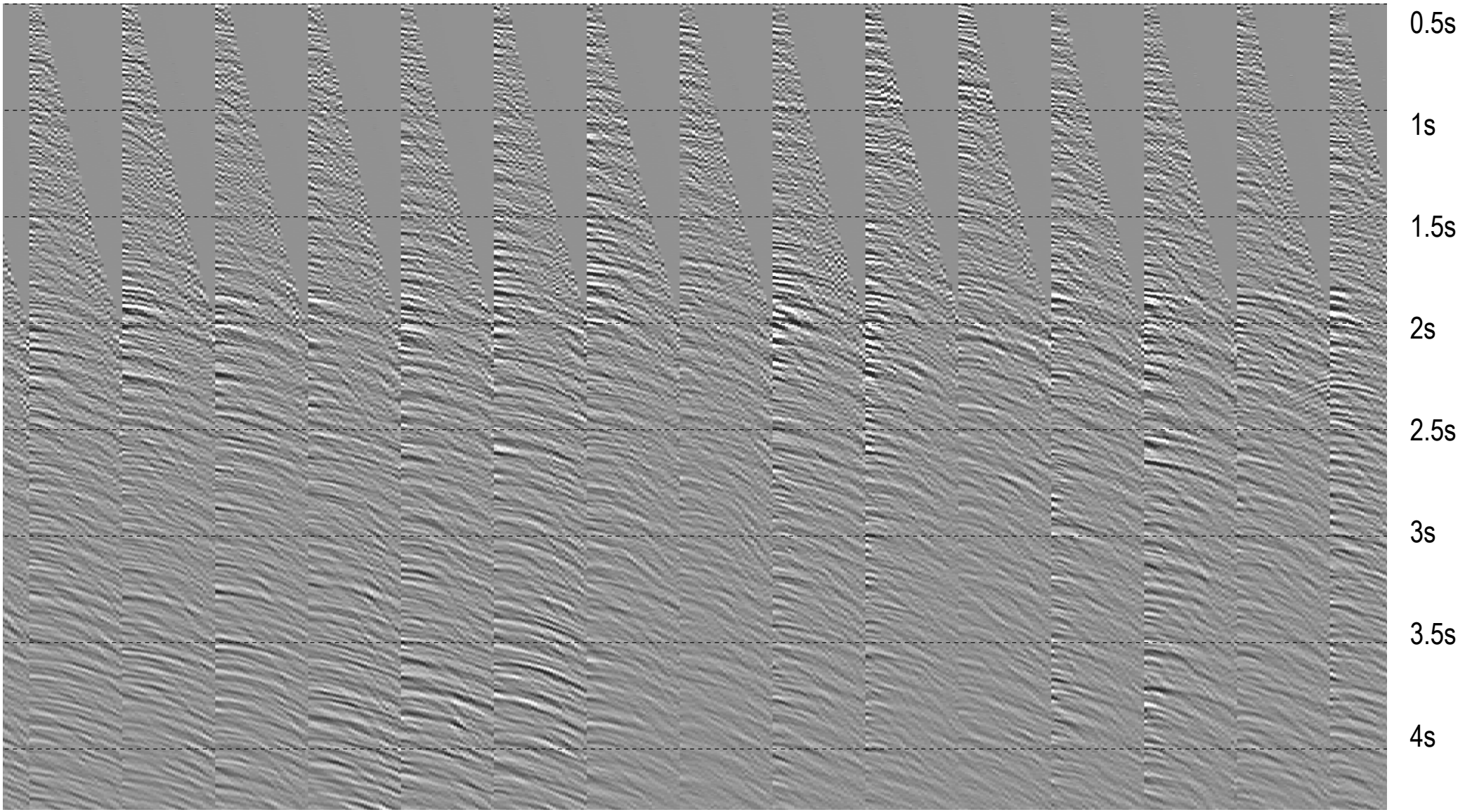
YOL00493 – Difference



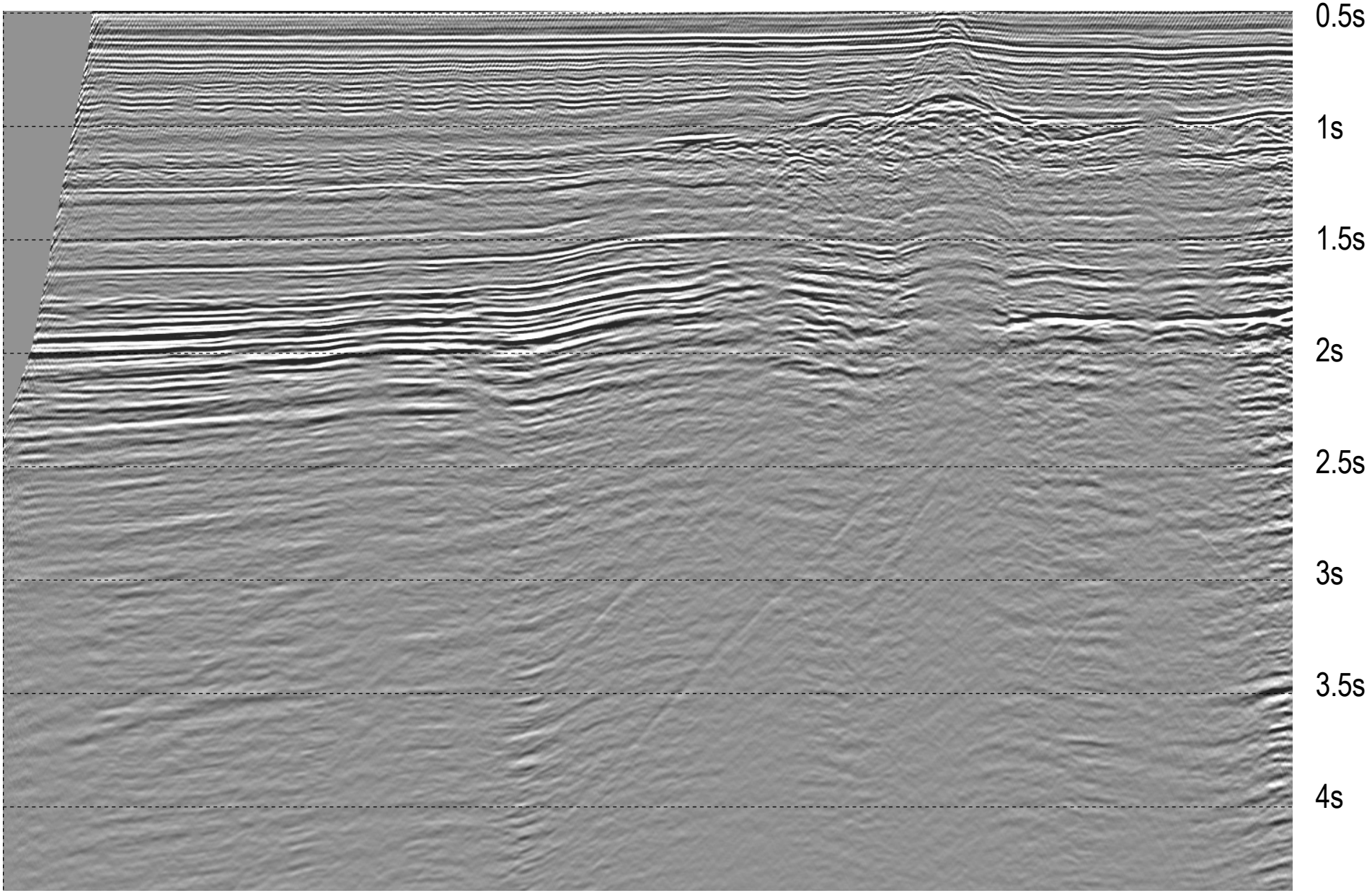
YOL00493 – Radon mute of 100ms at 3100m



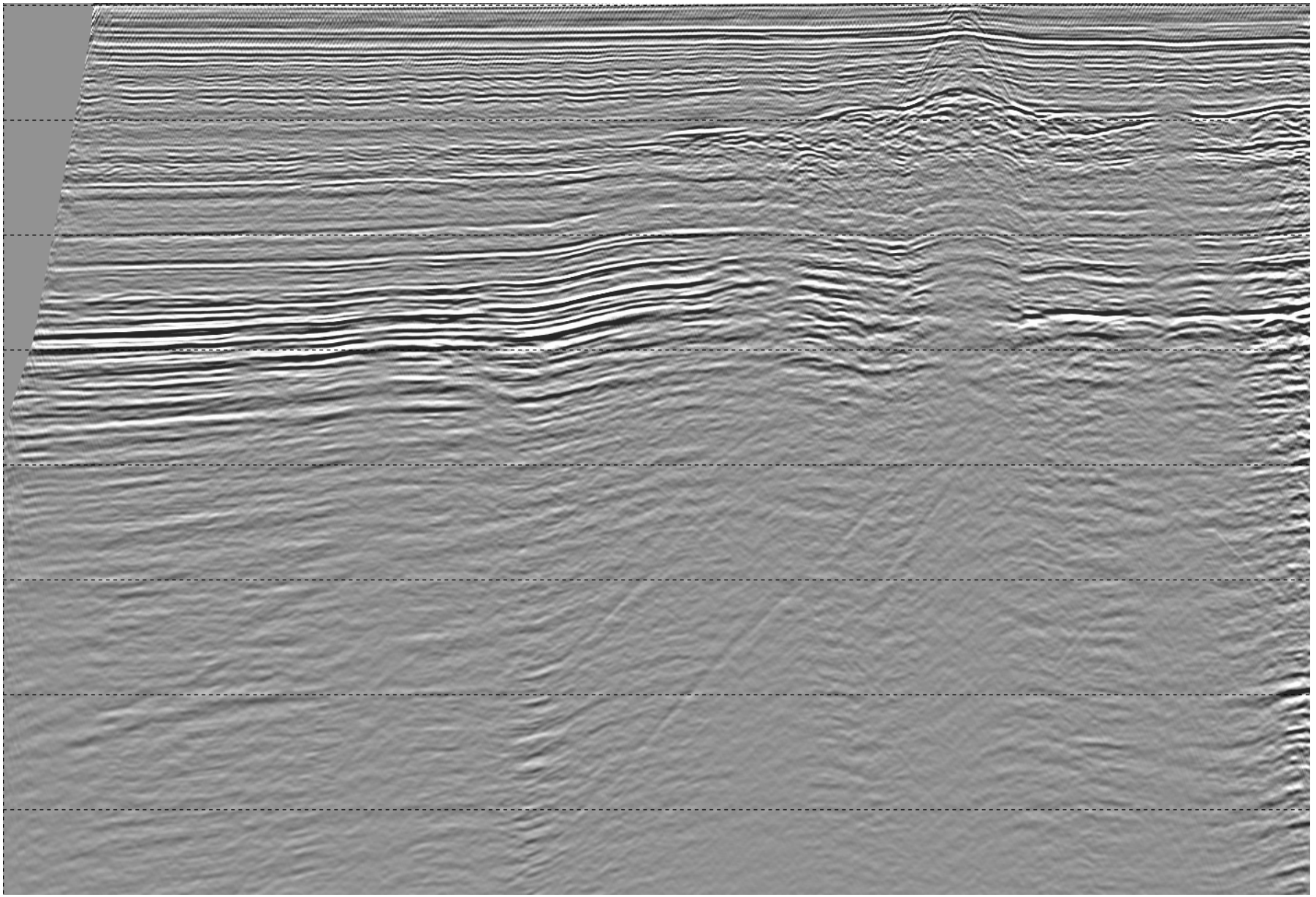
YOL00493 – Difference



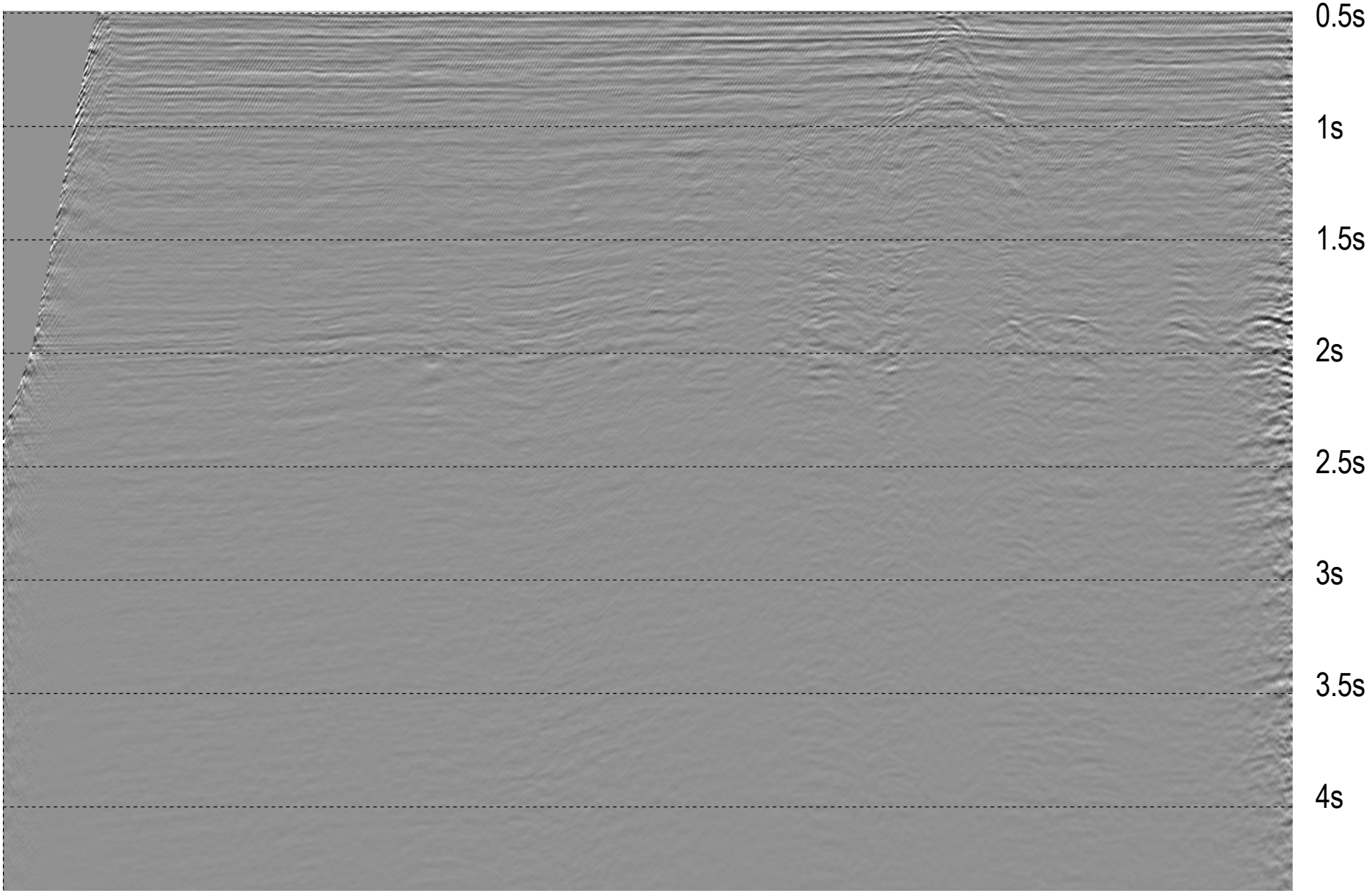
YOL00493 – Reference Stack



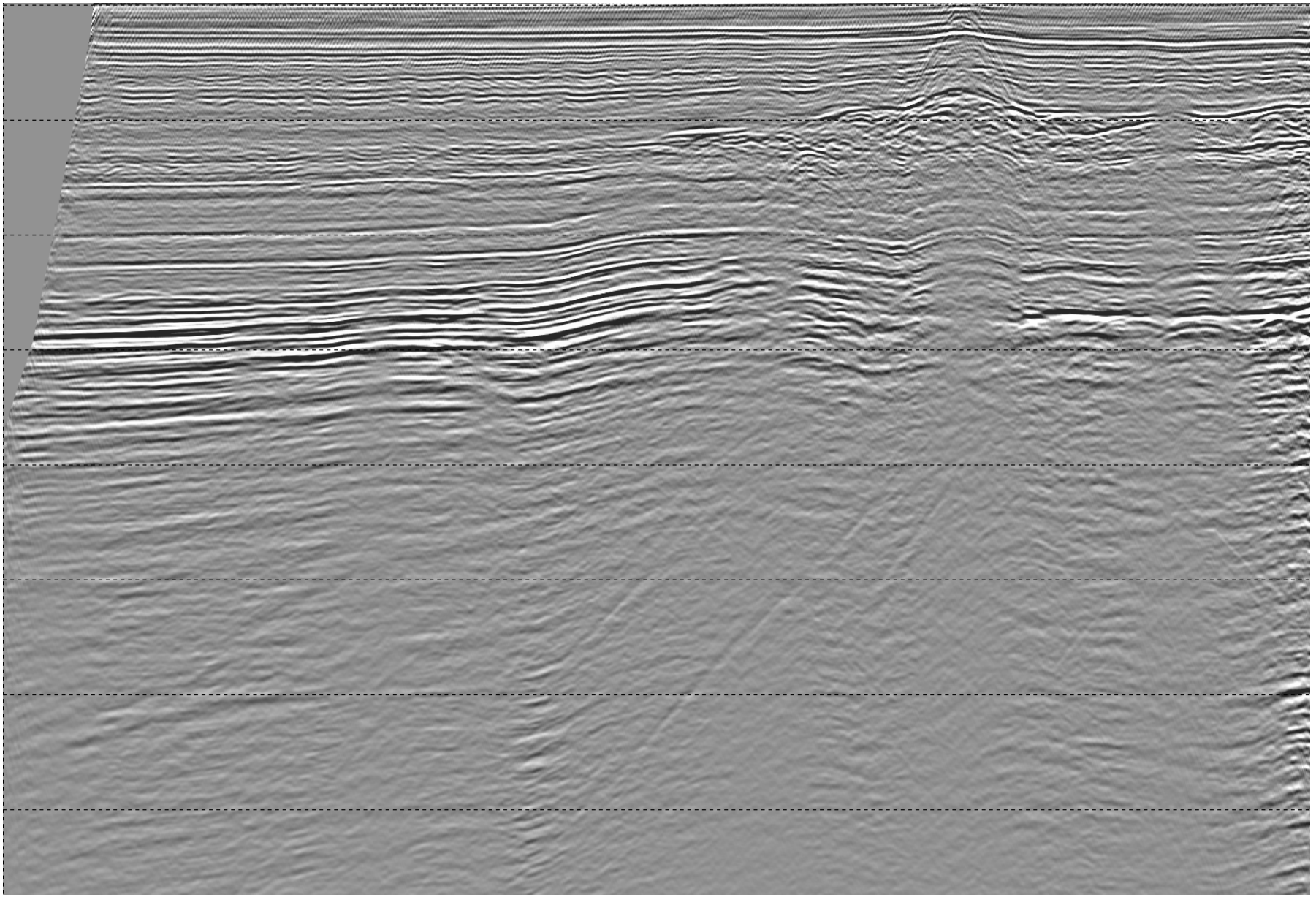
YOL00493 – Radon mute of 200ms at 3100m



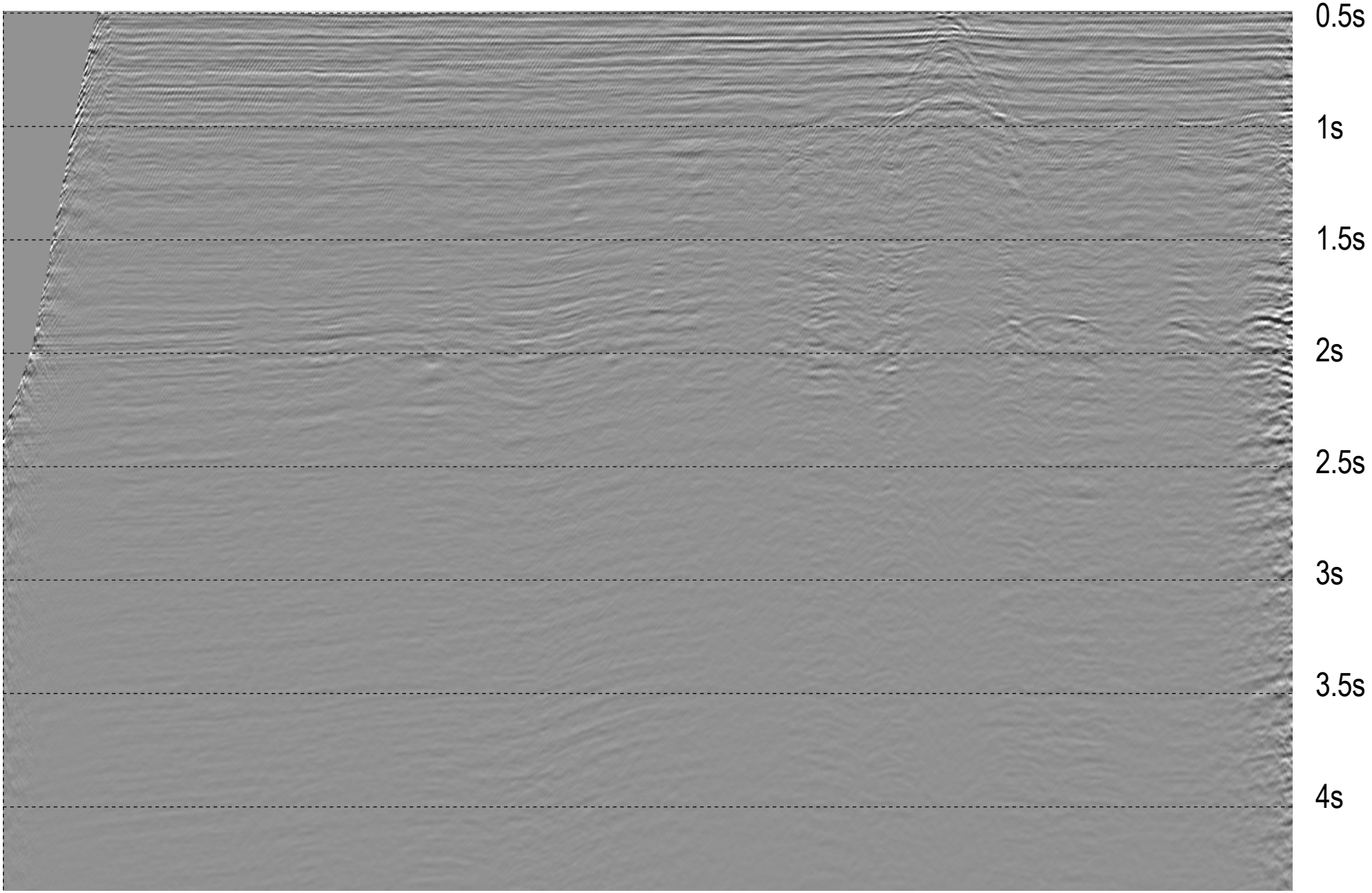
YOL00493 – Difference



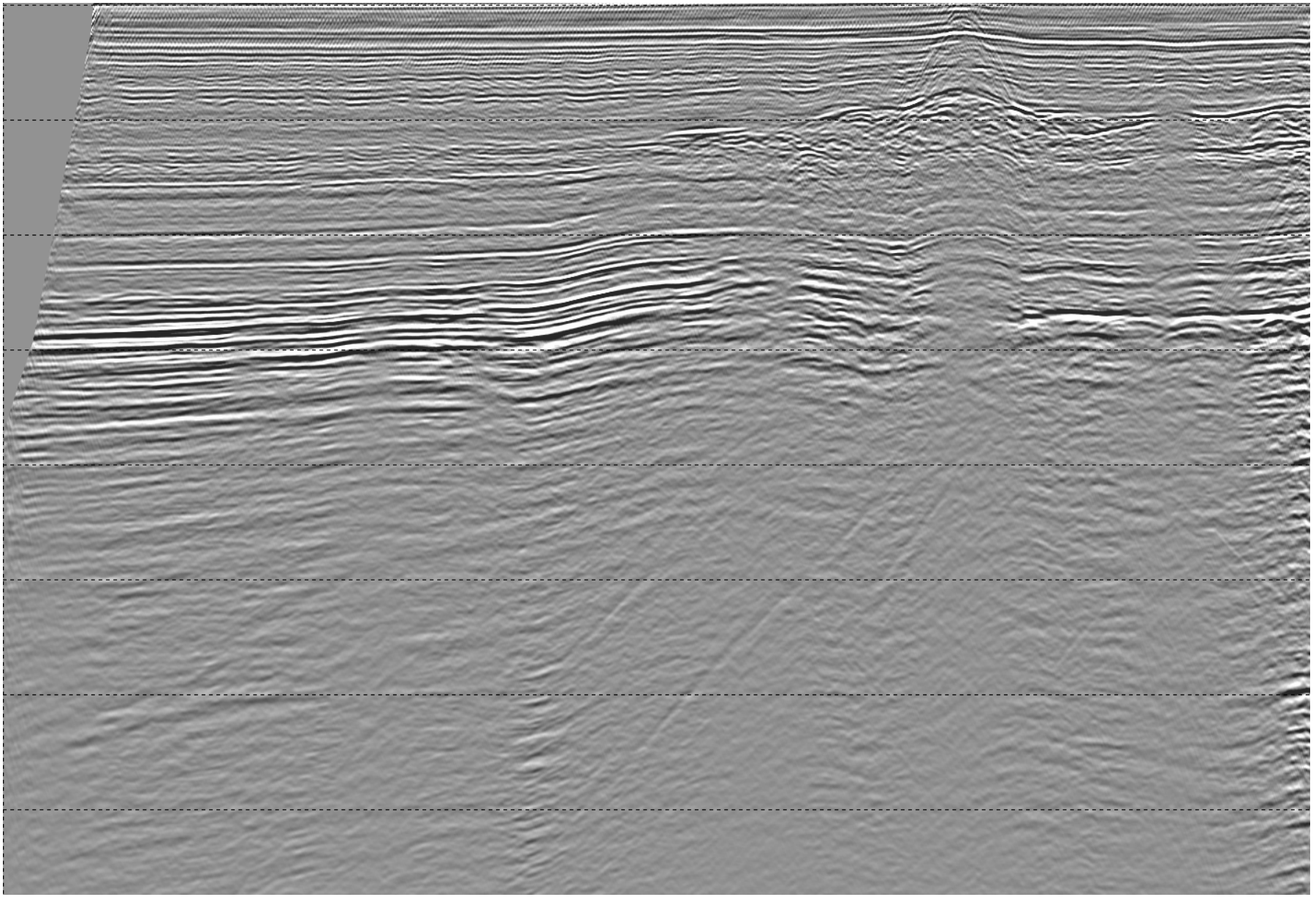
YOL00493 – Radon mute of 150ms at 3100m



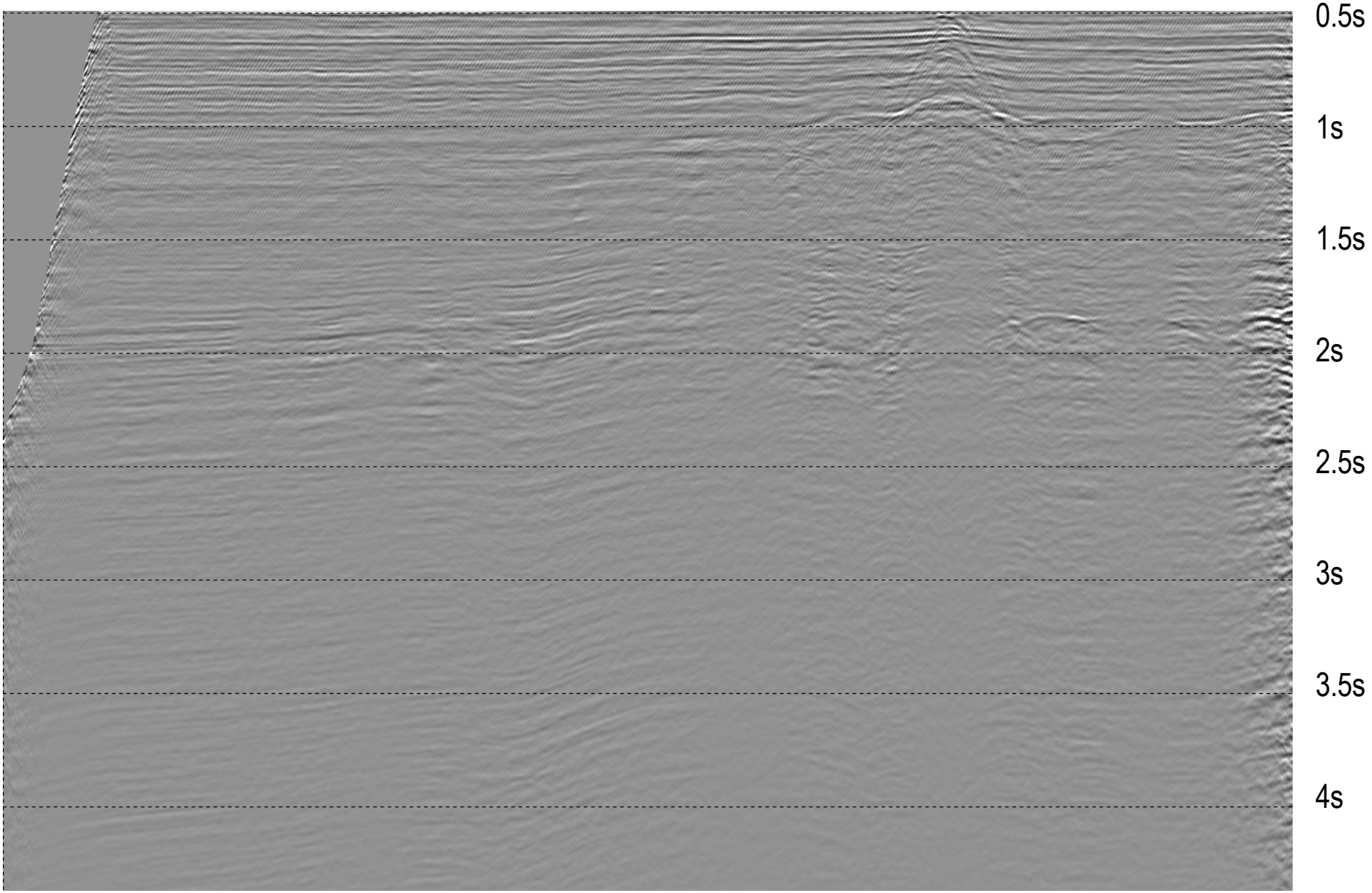
YOL00493 – Difference



YOL00493 – Radon mute of 100ms at 3100m

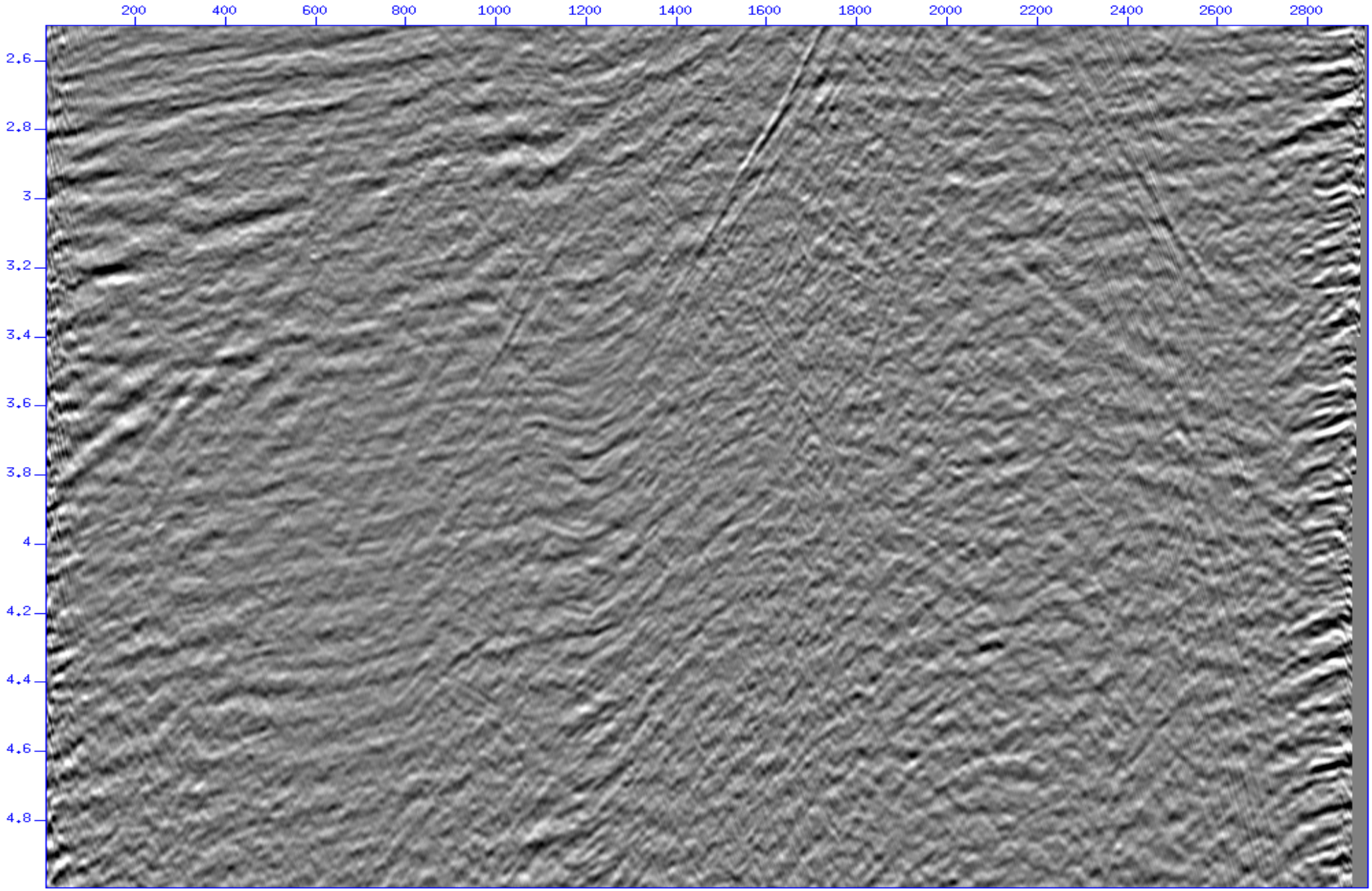


YOL00493 – Difference

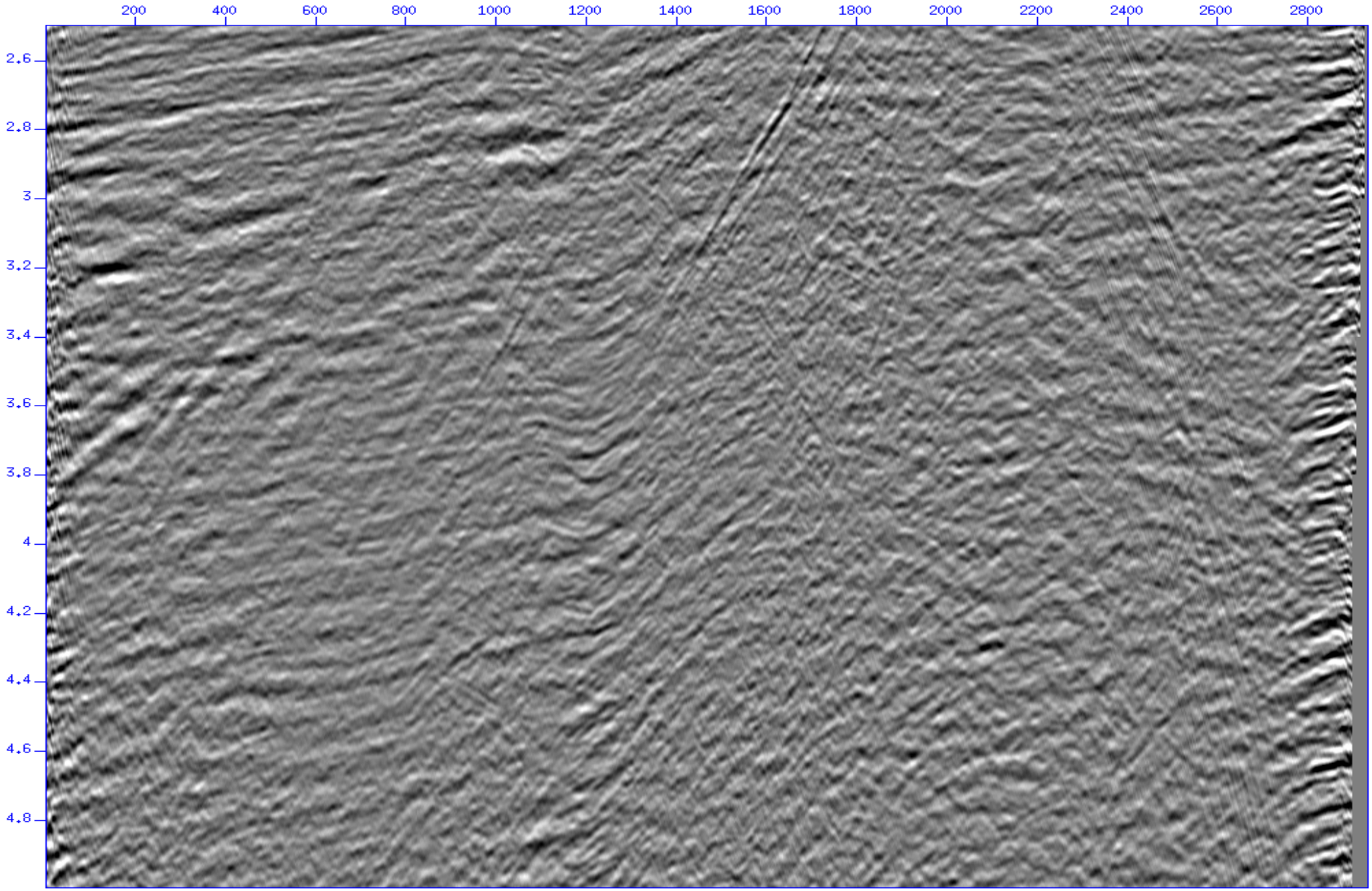


Deeper Sections

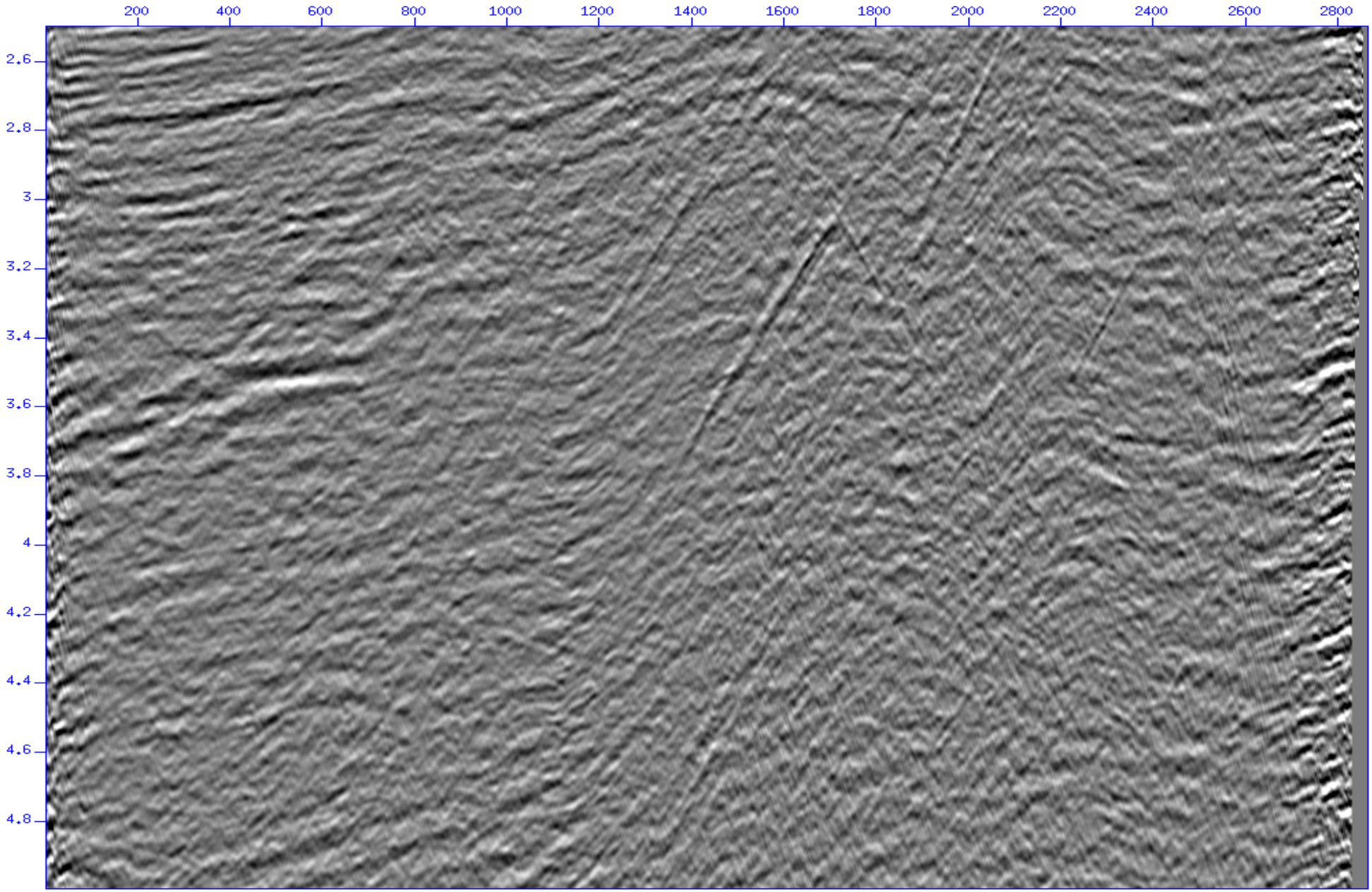
YOL00427 – Client Supplied Velocities



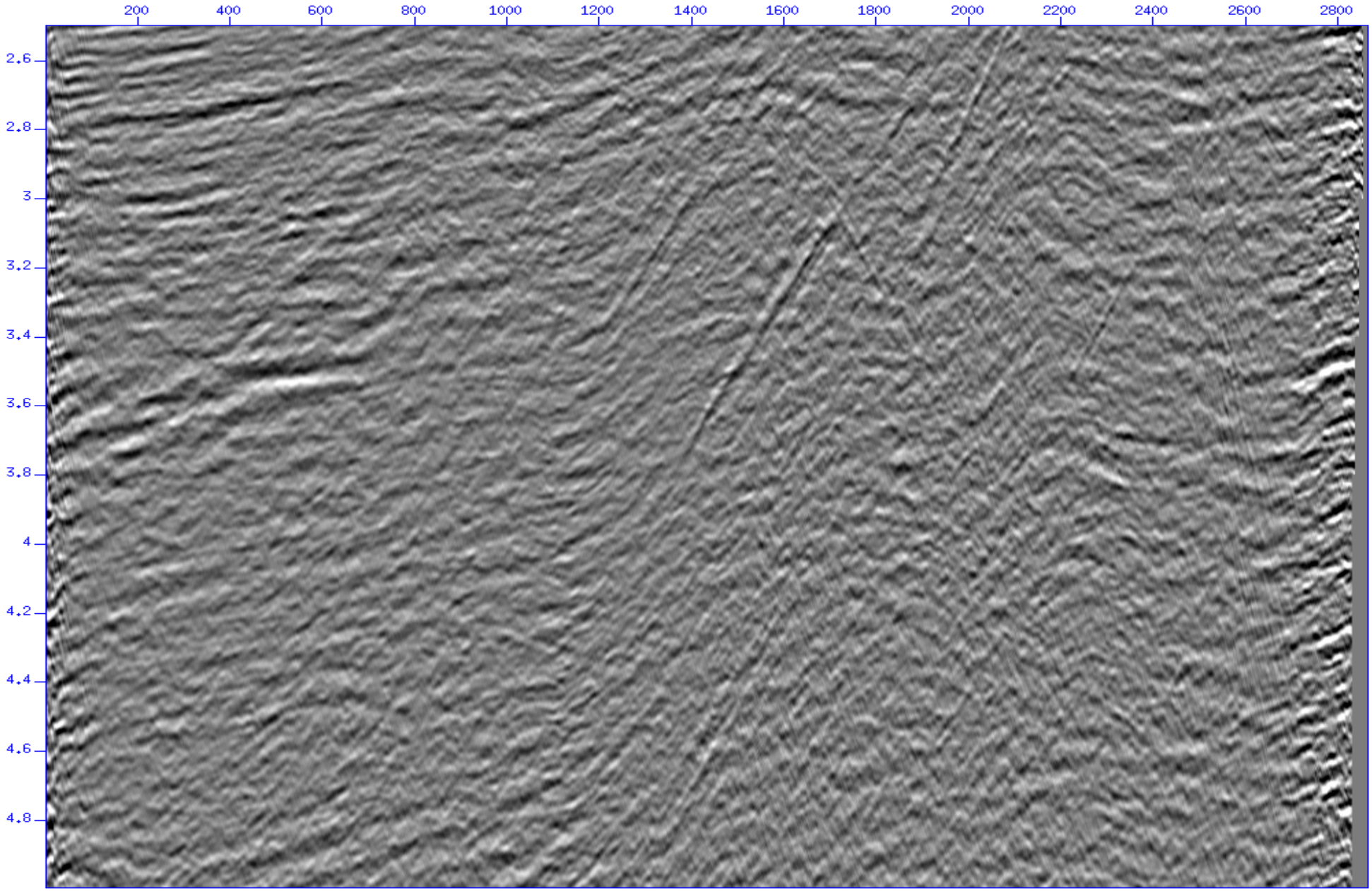
YOL00427 – DUG Velocities



YOL00493 – Client Supplied Velocities



YOL00493 – DUG Velocities



DownUnder GeoSolutions

Velocity Preparation for Migration

September 2009

Origin Energy Resources Ltd

Yolla 3D Marine Seismic Survey Reprocessing

- **OVERVIEW OF MODEL-BUILDING STRATEGY**
- WELL TIES
- VELOCITY MODEL SCALING

Derivation of a Geostatistical Velocity Model

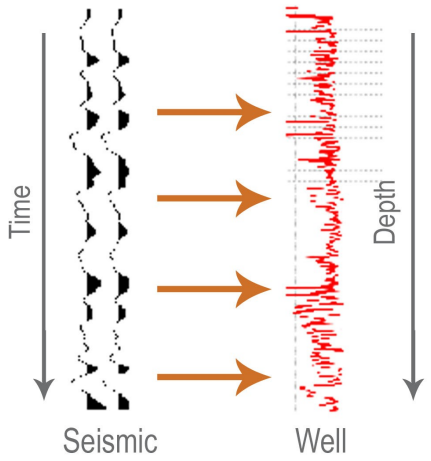
For Anisotropic Migration

- The model-building workflow has involved the following:
  - Calibration of time depth pairs via synthetics.
    - Emphasis has been placed on achieving a good synthetic-to-seismic well tie; and ensuring checkshot velocities mimic the interval velocity of the well.
  - Smoothing of initial seismic-derived interval velocities.
  - Geostatistical scaling of the initial velocity model to tie the well control and produce a velocity model which provides the most accurate depth conversion.
    - Geostatistical scaling enforces geophysically and geologically constrained geostatistics which utilise all available information (existing velocity models, seismic horizons and well data) to produce a data consistent update.
    - The background trend is a stable, long wavelength solution in the form of a polynomial function of geologically meaningful and measurable quantities.
    - The following slide provides an overview of the velocity model scaling workflow.

Velocity Model Scaling Strategy

STEP ONE

TD-Mapping



Calibrated TD Pairs

T1 → D1
T2 → D2
T3 → D3
T4 → D4

STEP TWO

Depth convert times using initial velocity model

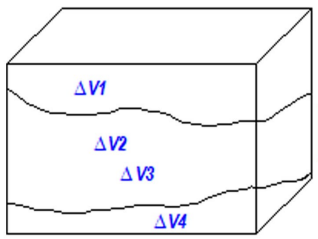
T1 → D1i
T2 → D2i
T3 → D3i
T4 → D4i

Compare depths and calculate Velocity Errors

ΔV1 → D1 vs D1i
ΔV2 → D2 vs D2i
ΔV3 → D3 vs D3i
ΔV4 → D4 vs D4i

STEP THREE

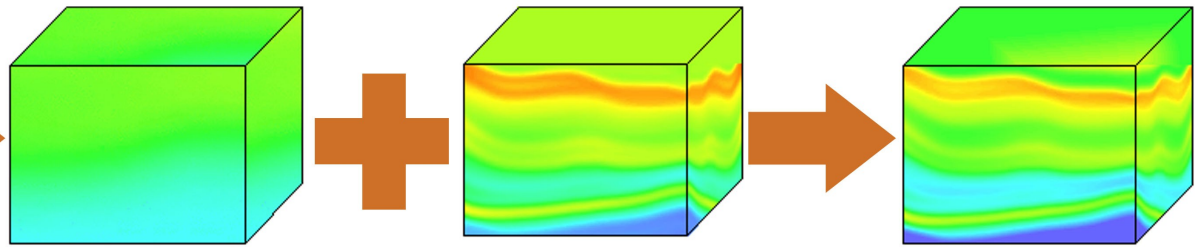
Distribute Velocity Errors in 3D using Geophysically Constrained Geostatistics



Constraints include Horizons, Depths, Water Depth etc....

STEP FOUR

Scale initial velocity model to account for Velocity Error volume.



Velocity Error Volume

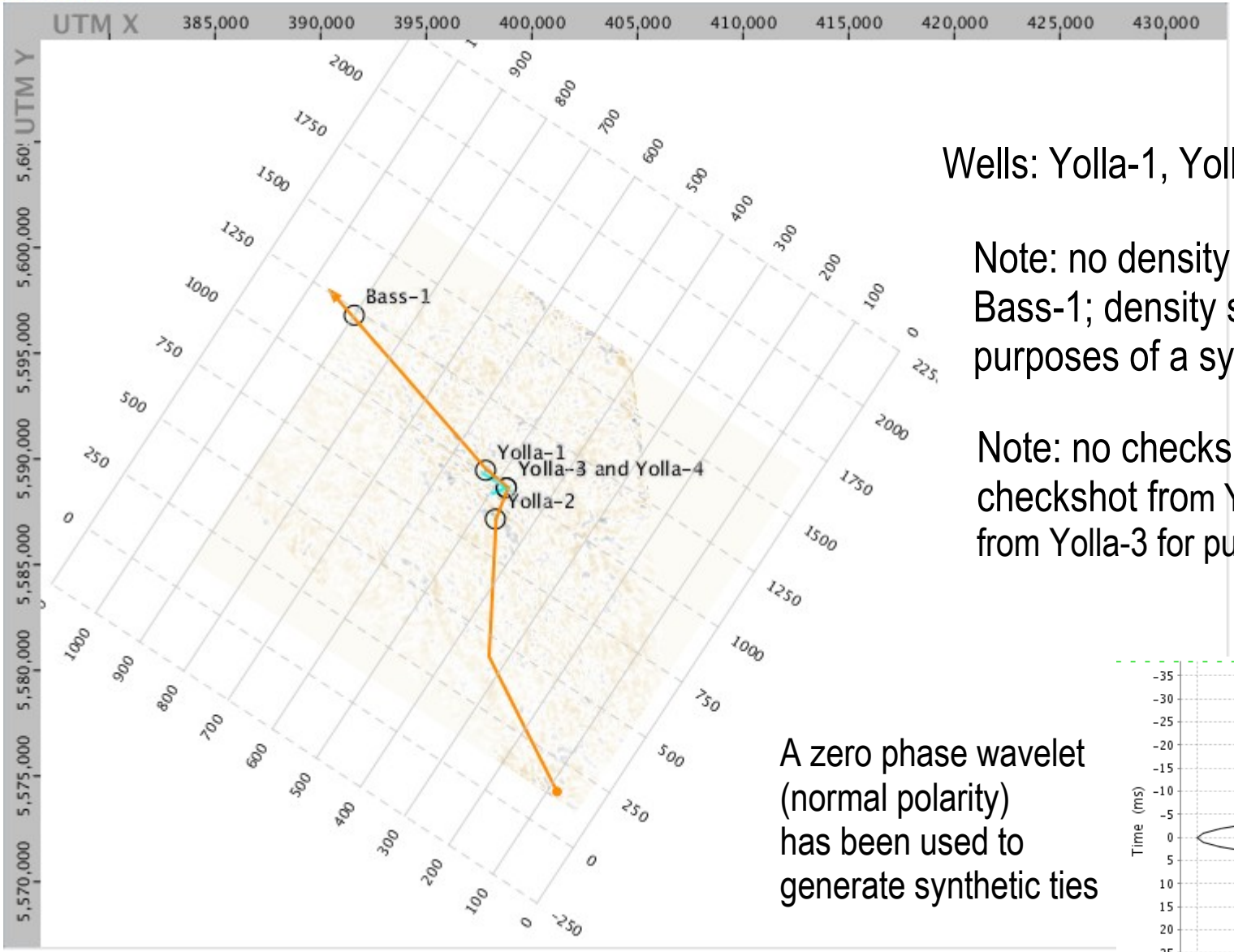
Initial Velocity Model

Scaled Velocity Model

Scaled model will produce TD conversions (and vice versa) that tie the well data.

- OVERVIEW OF MODEL-BUILDING STRATEGY
- **WELL TIES**
- VELOCITY MODEL SCALING

Data for Well Ties

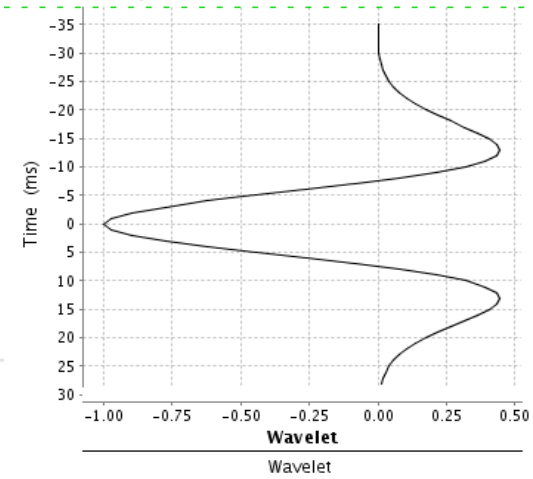


Wells: Yolla-1, Yolla-2, Yolla-3 and Bass-1

Note: no density curve available for Bass-1; density set to 2.0g/cc for the purposes of a synthetic tie

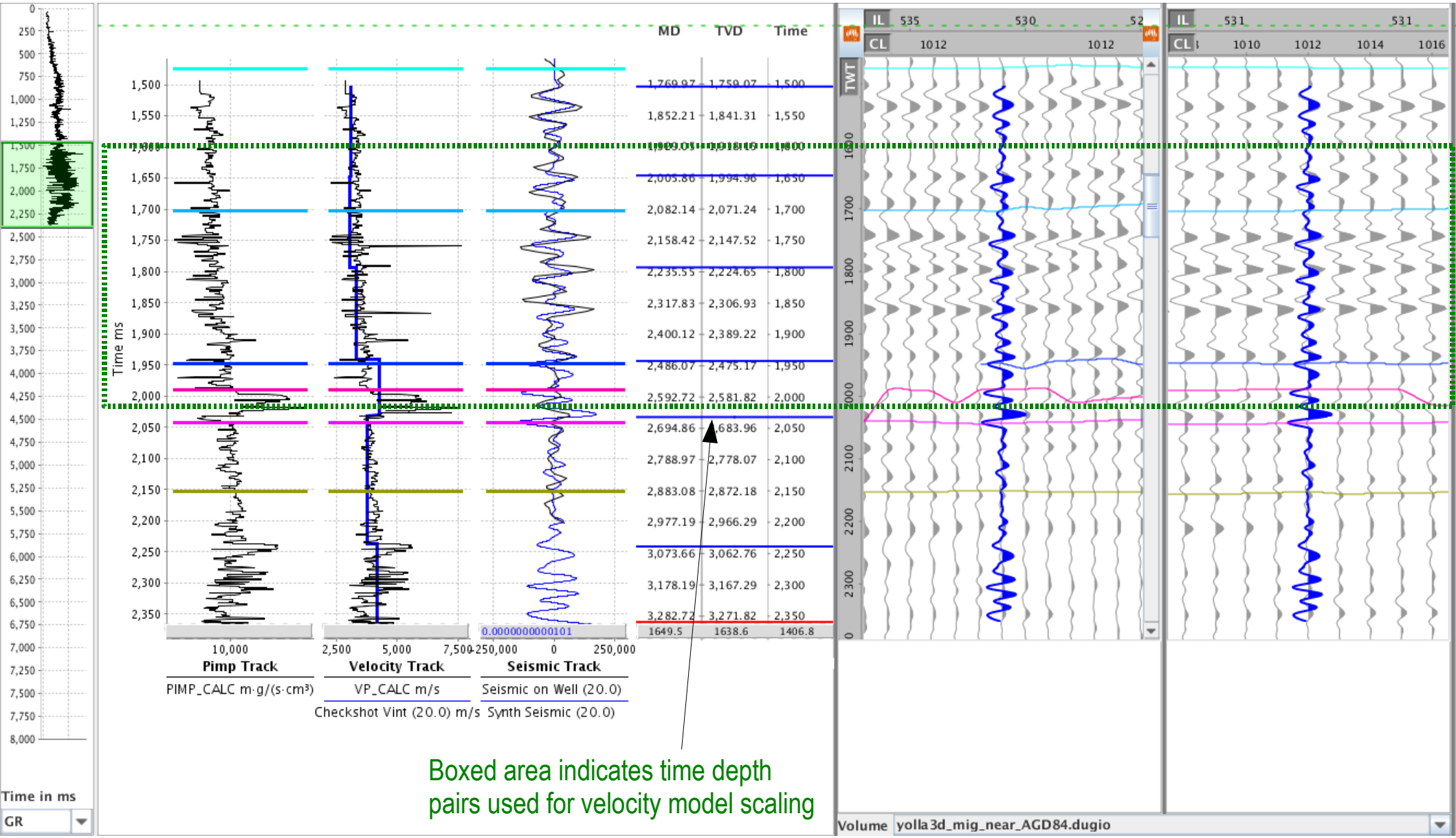
Note: no checkshot for Yolla-3; using checkshot from Yolla-4 and sonic log from Yolla-3 for purposes of a synthetic tie

A zero phase wavelet (normal polarity) has been used to generate synthetic ties



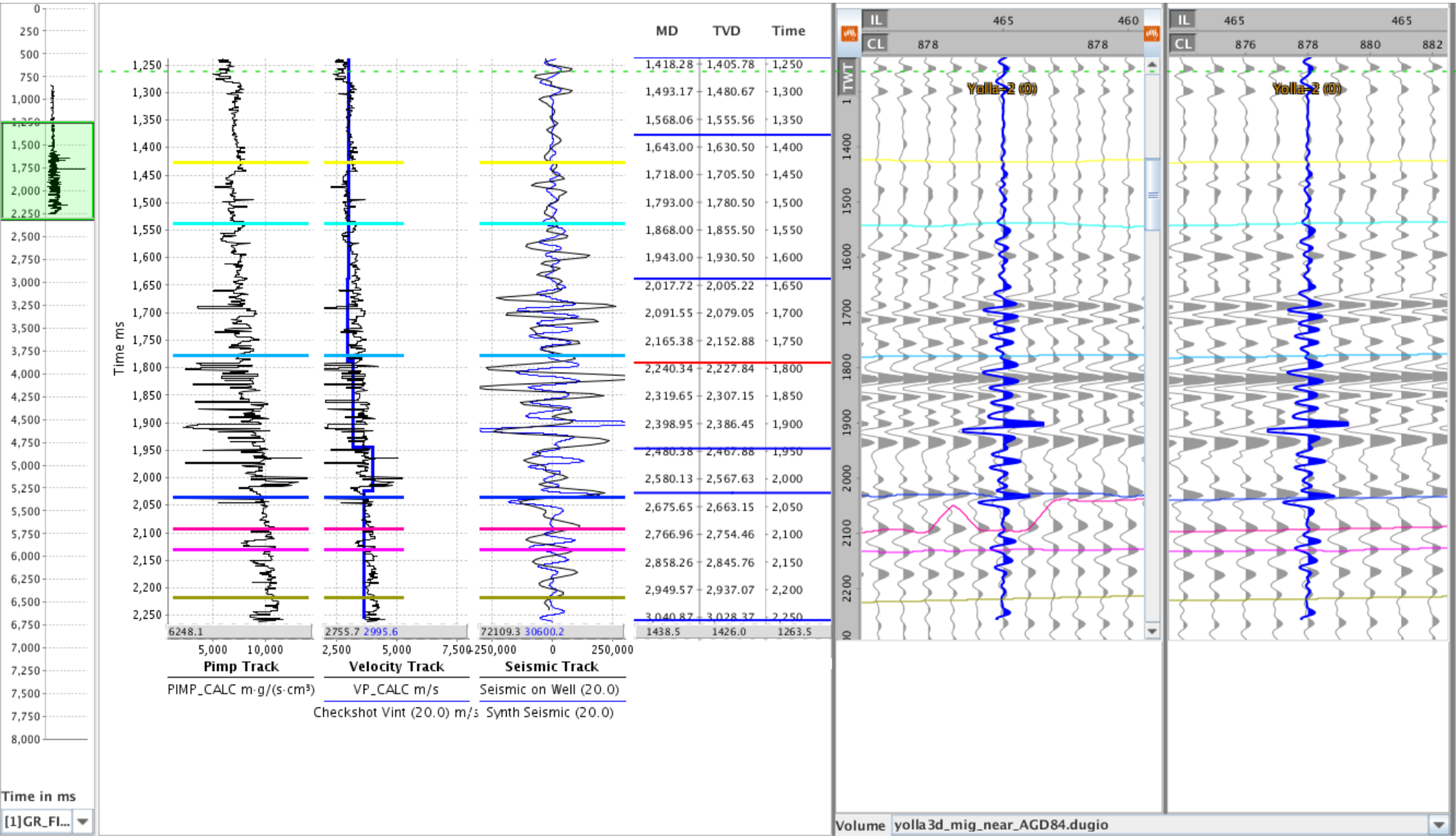
The time-depth pairs derived from the Yolla-1 tie have been deemed the most reliable input for velocity model scaling.

Well Synthetic: Yolla-1

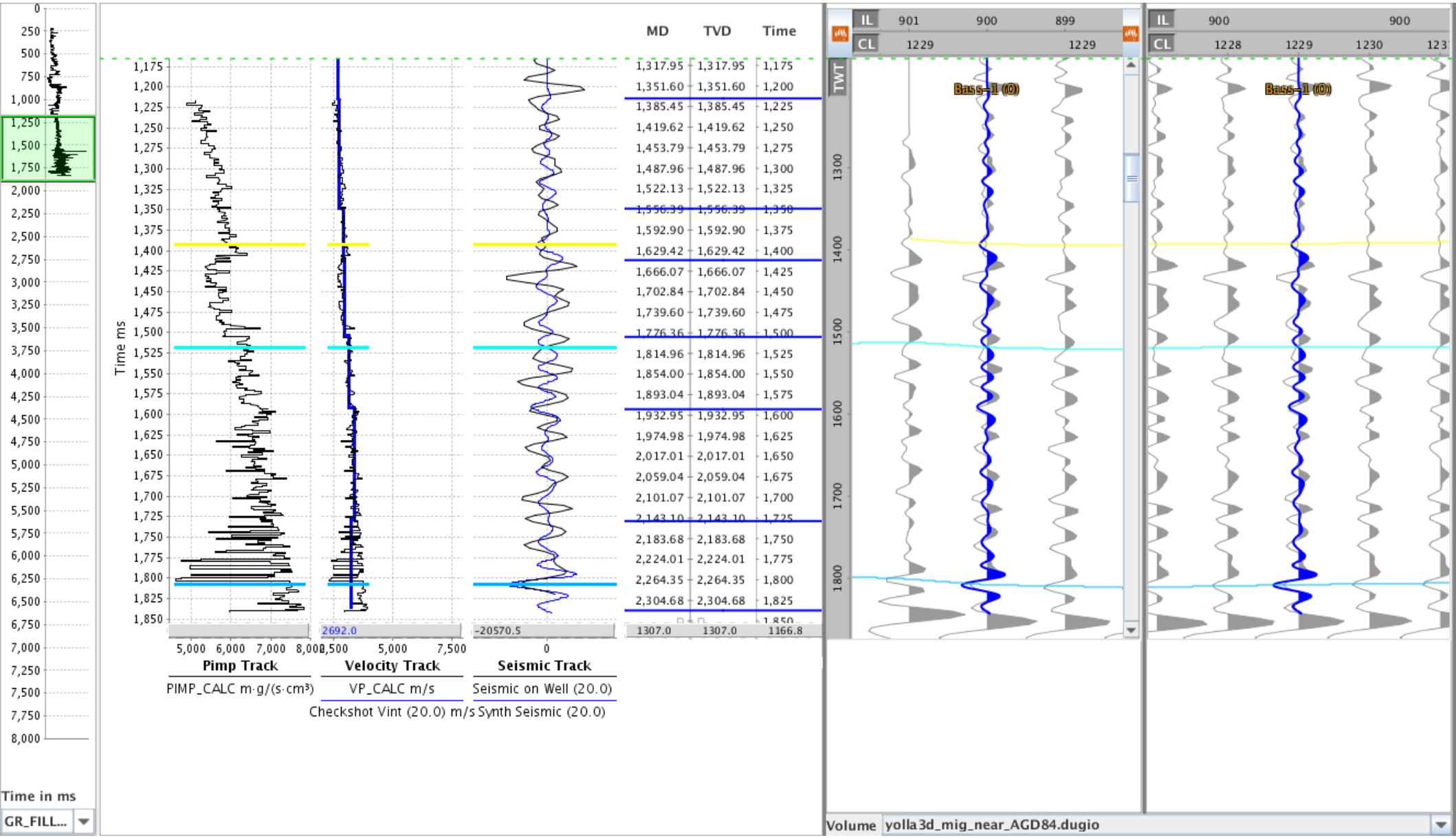


Boxed area indicates time depth pairs used for velocity model scaling

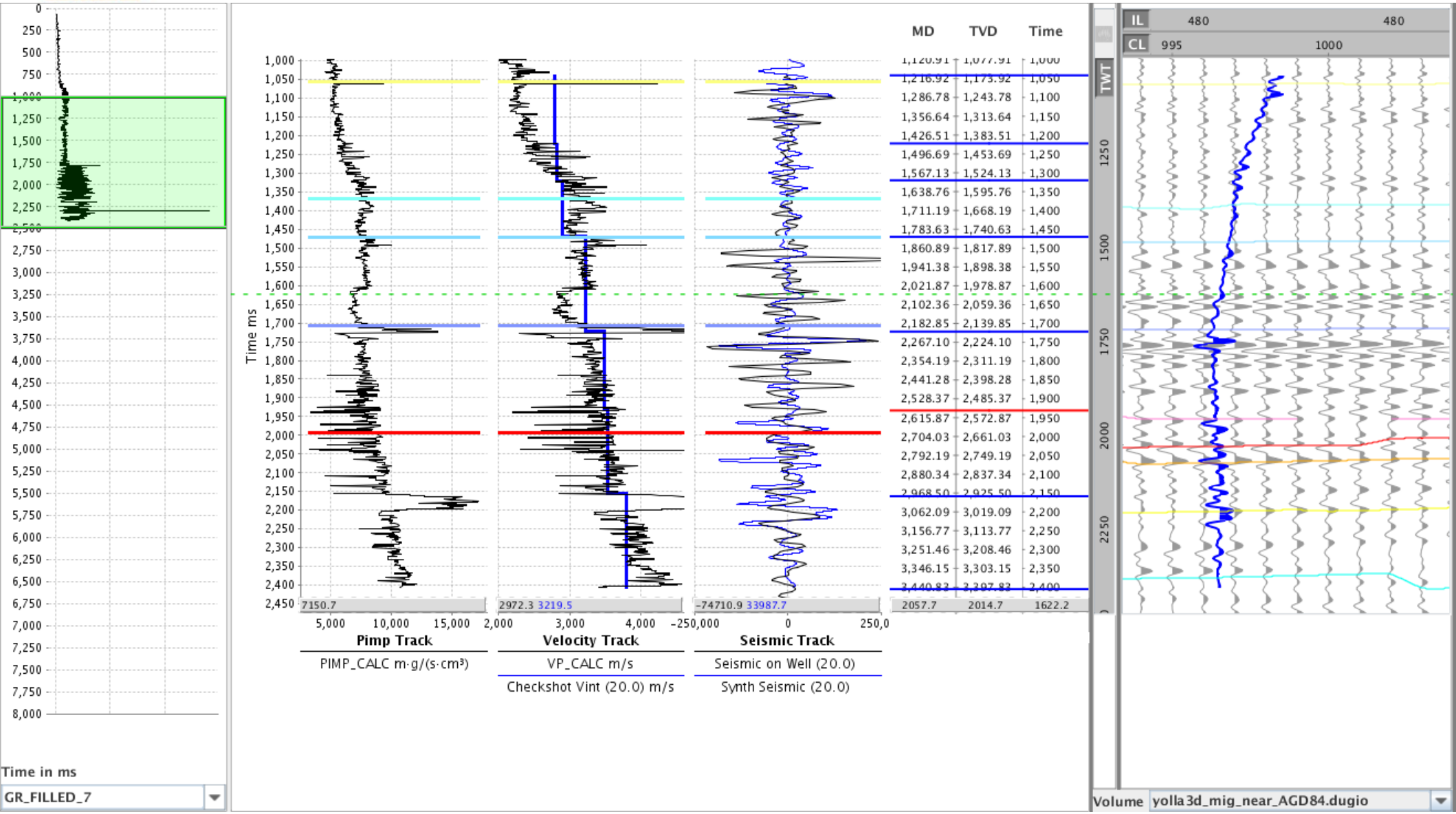
Well Synthetic: Yolla-2



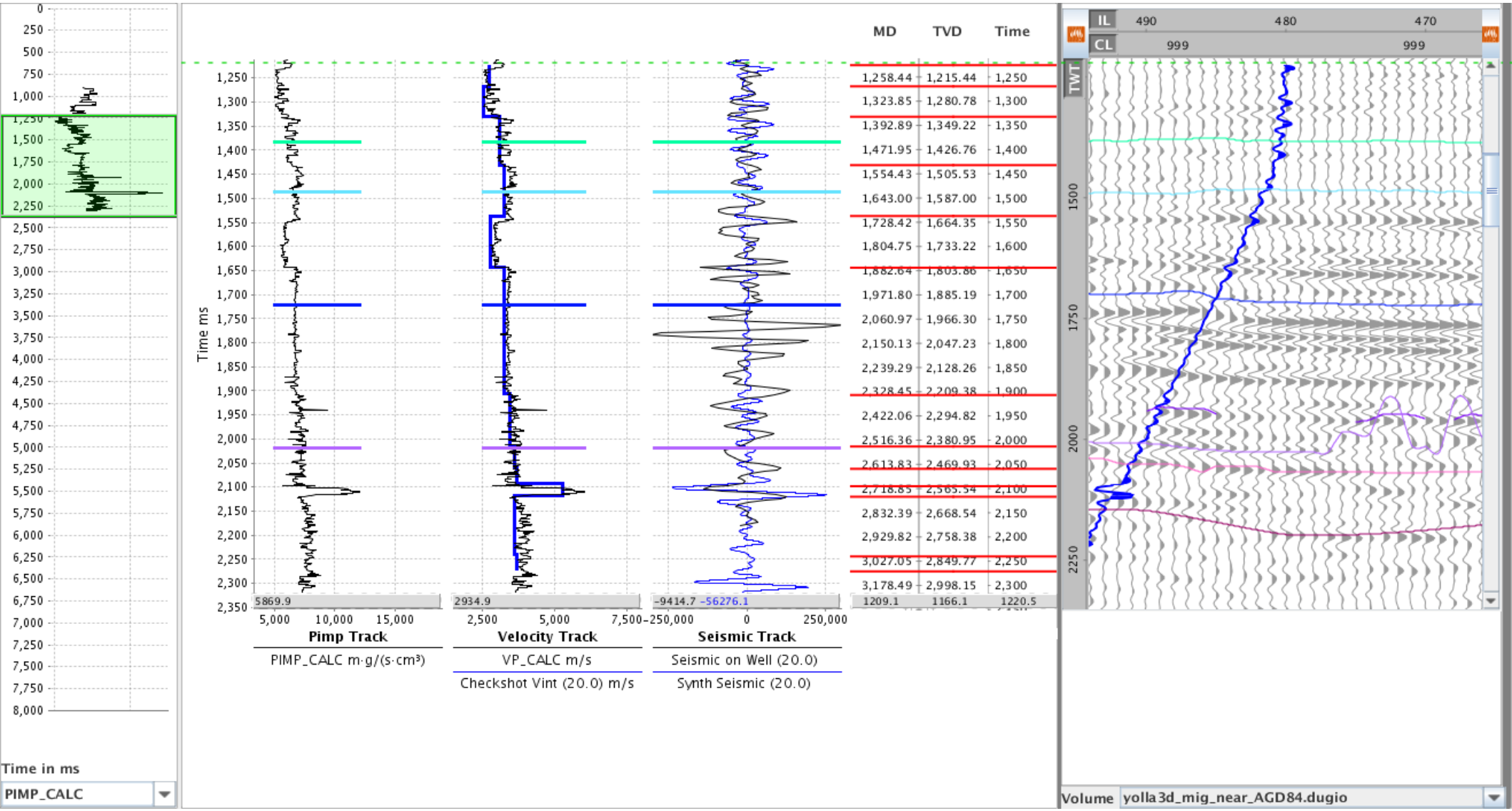
Well Synthetic: Bass-1



Well Synthetic: Yolla-3



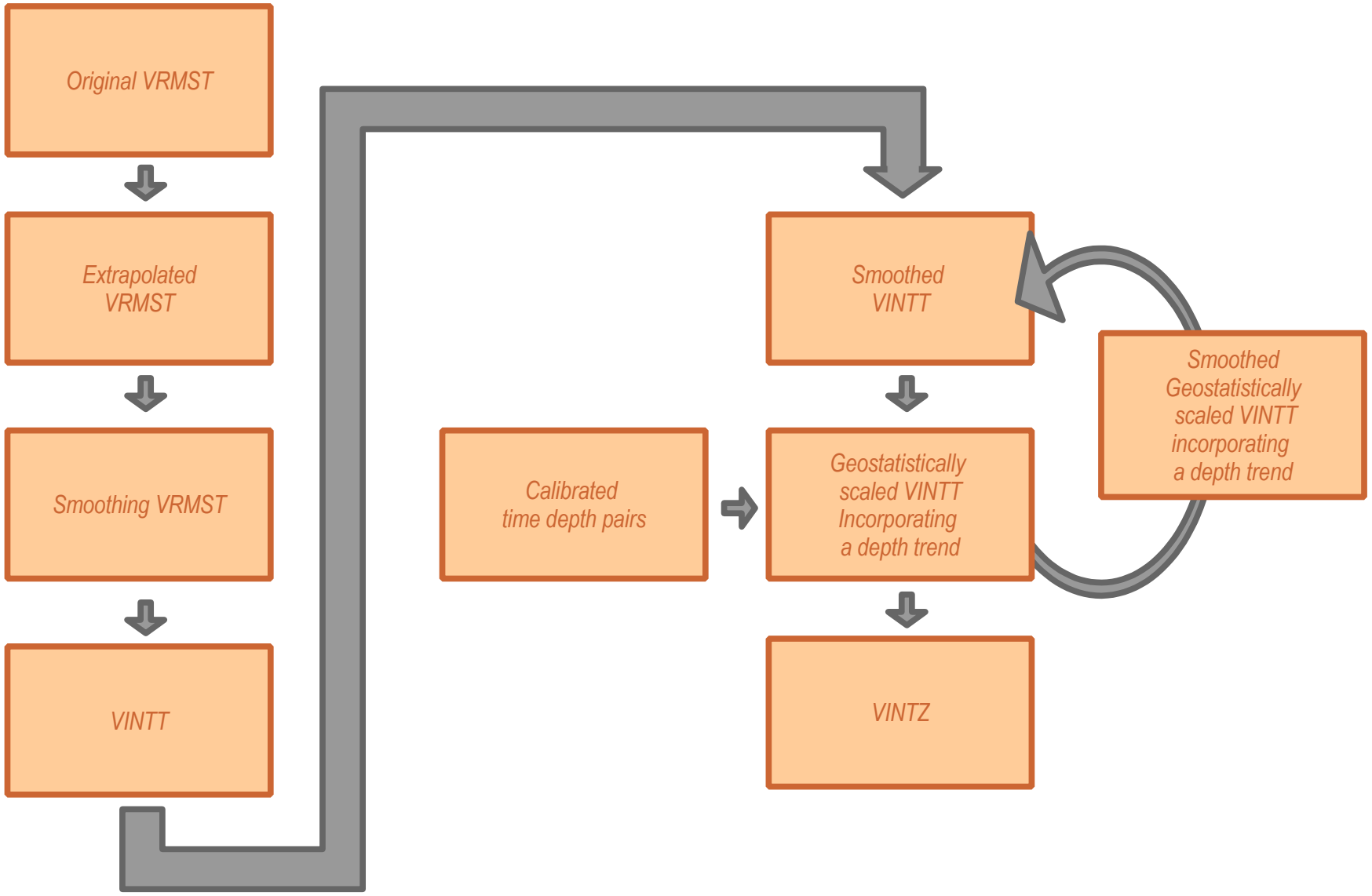
Well Synthetic: Yolla-4



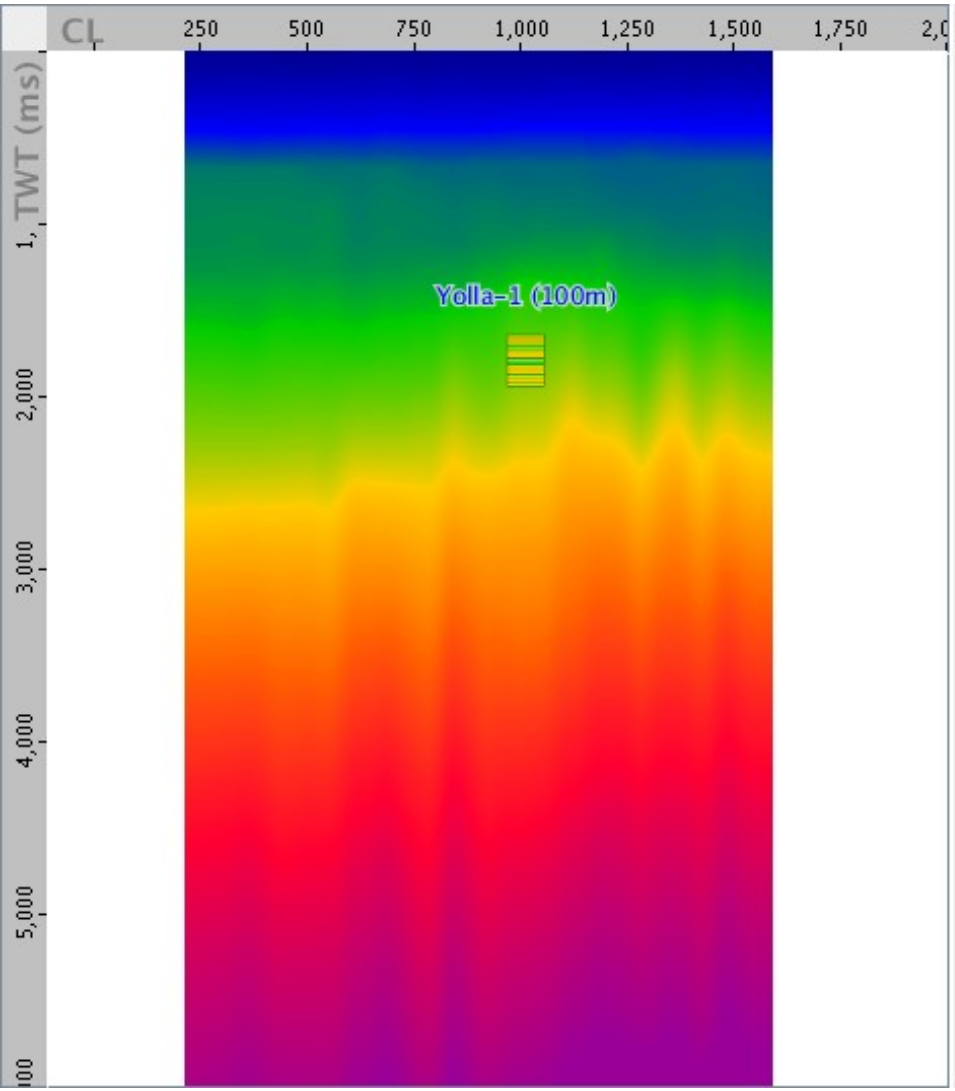
- OVERVIEW OF MODEL-BUILDING STRATEGY
- WELL TIES
- **VELOCITY MODEL SCALING**

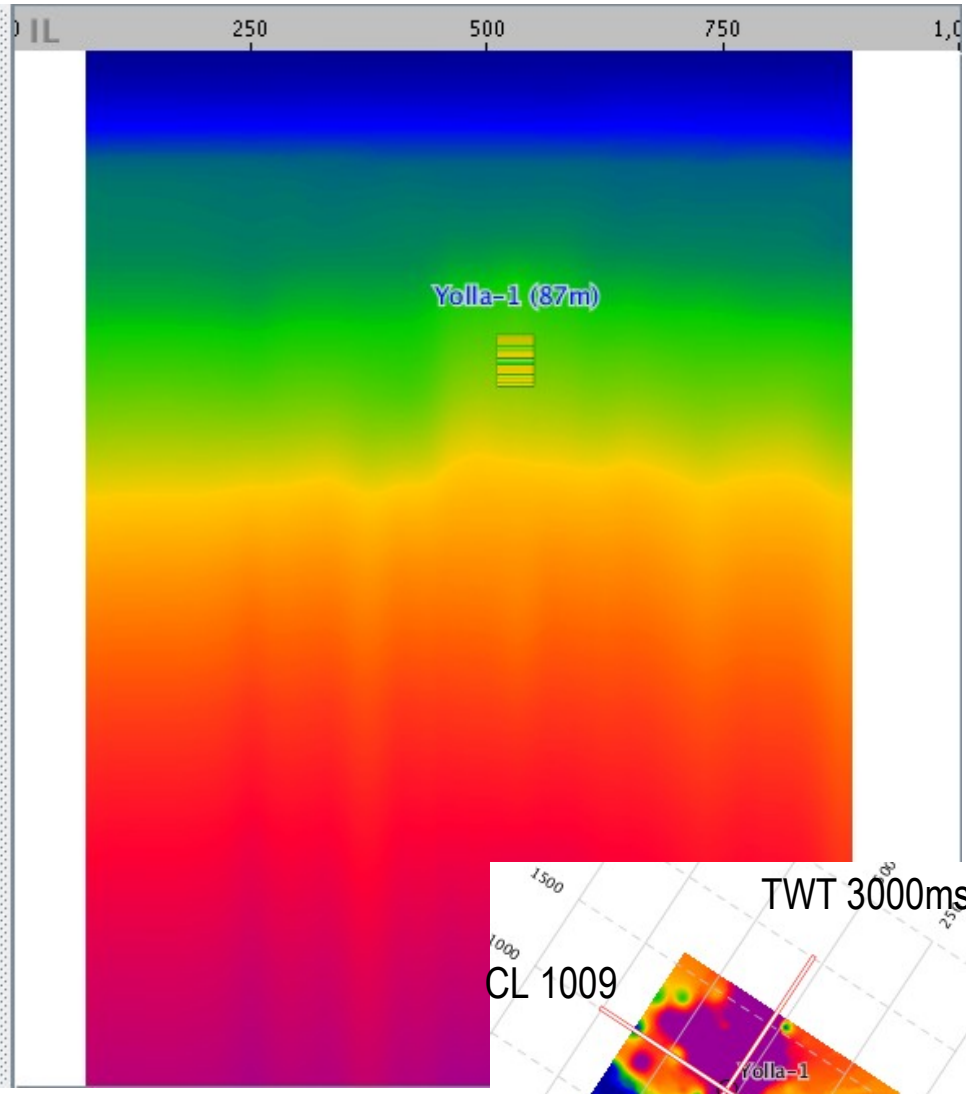
Derivation of a velocity model

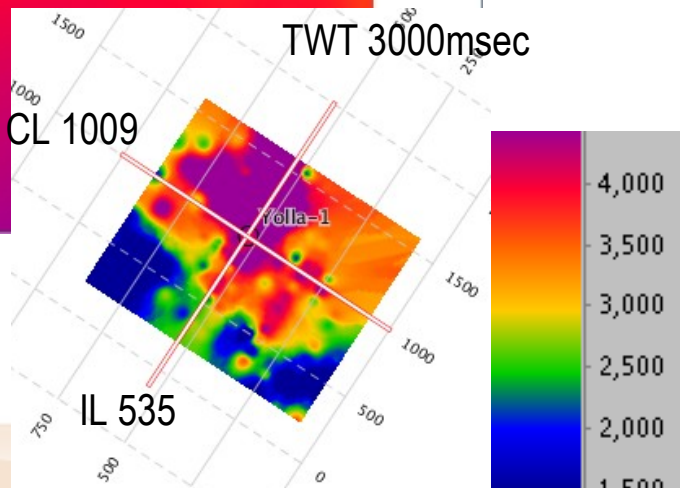
For Anisotropic Migration



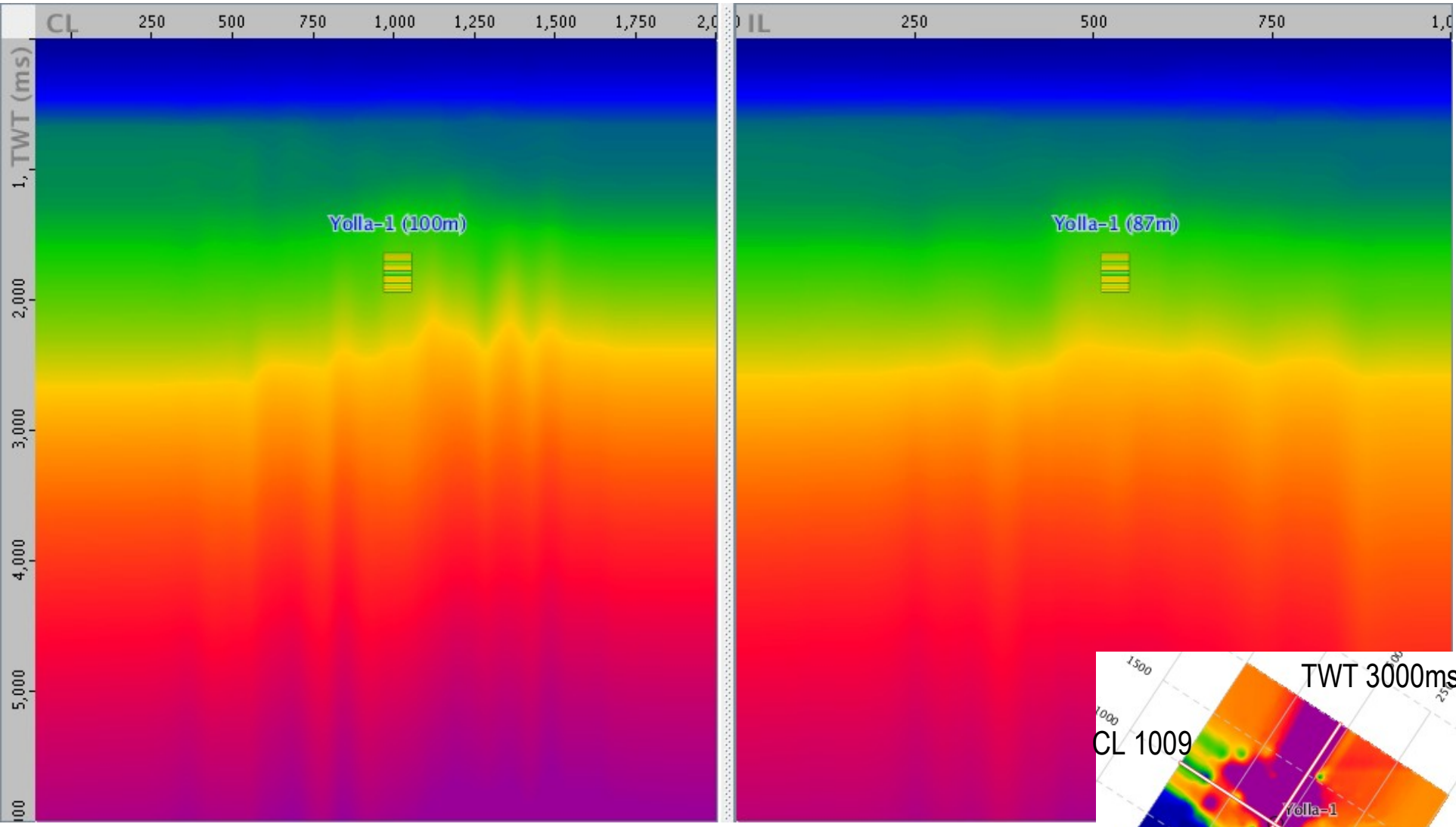
VRMST from first round of post migration picks

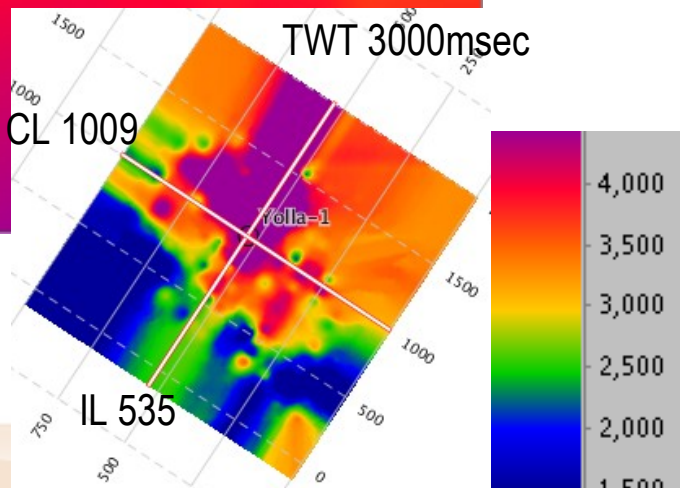






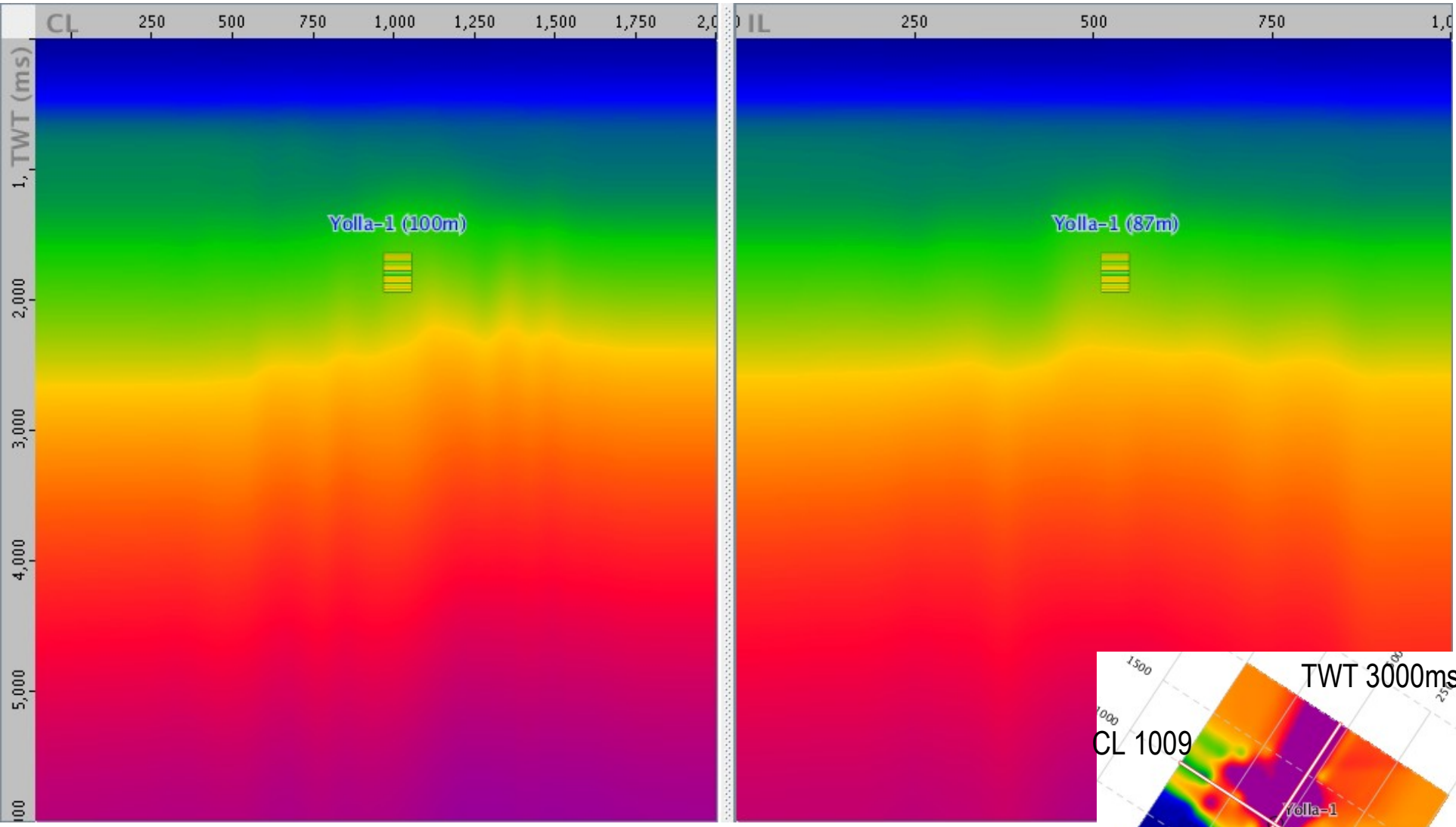
Extrapolated VRMST

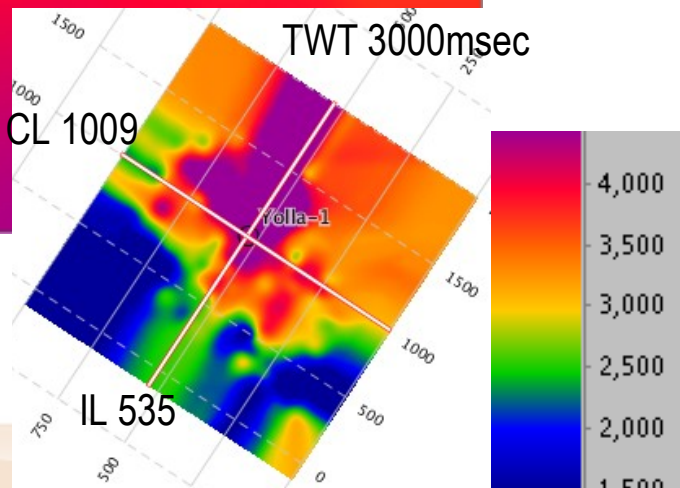




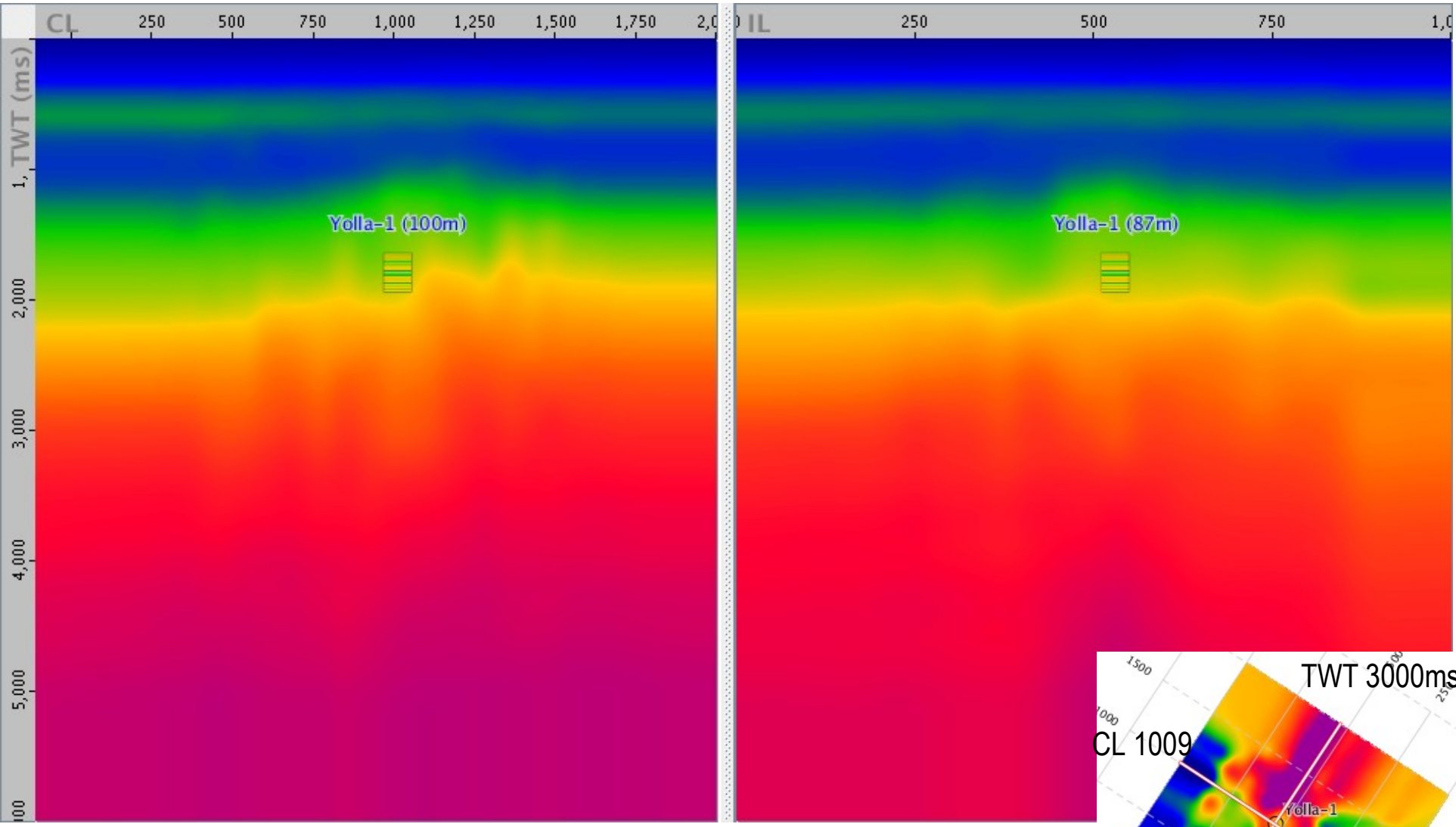
Smoothed VRMST

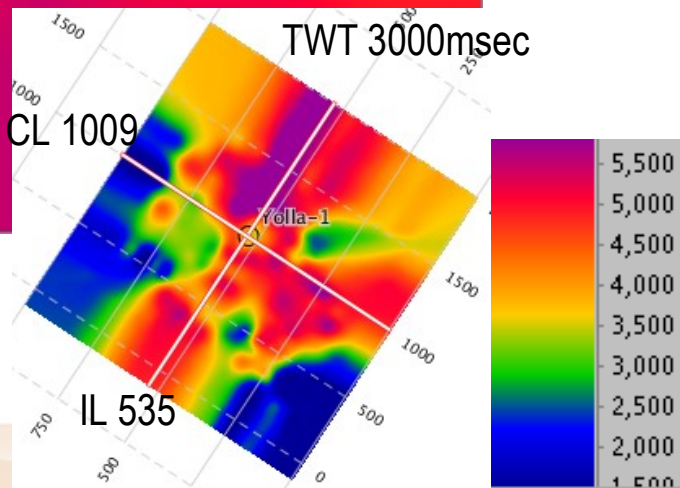
with 800m x 800m x 360msec filter





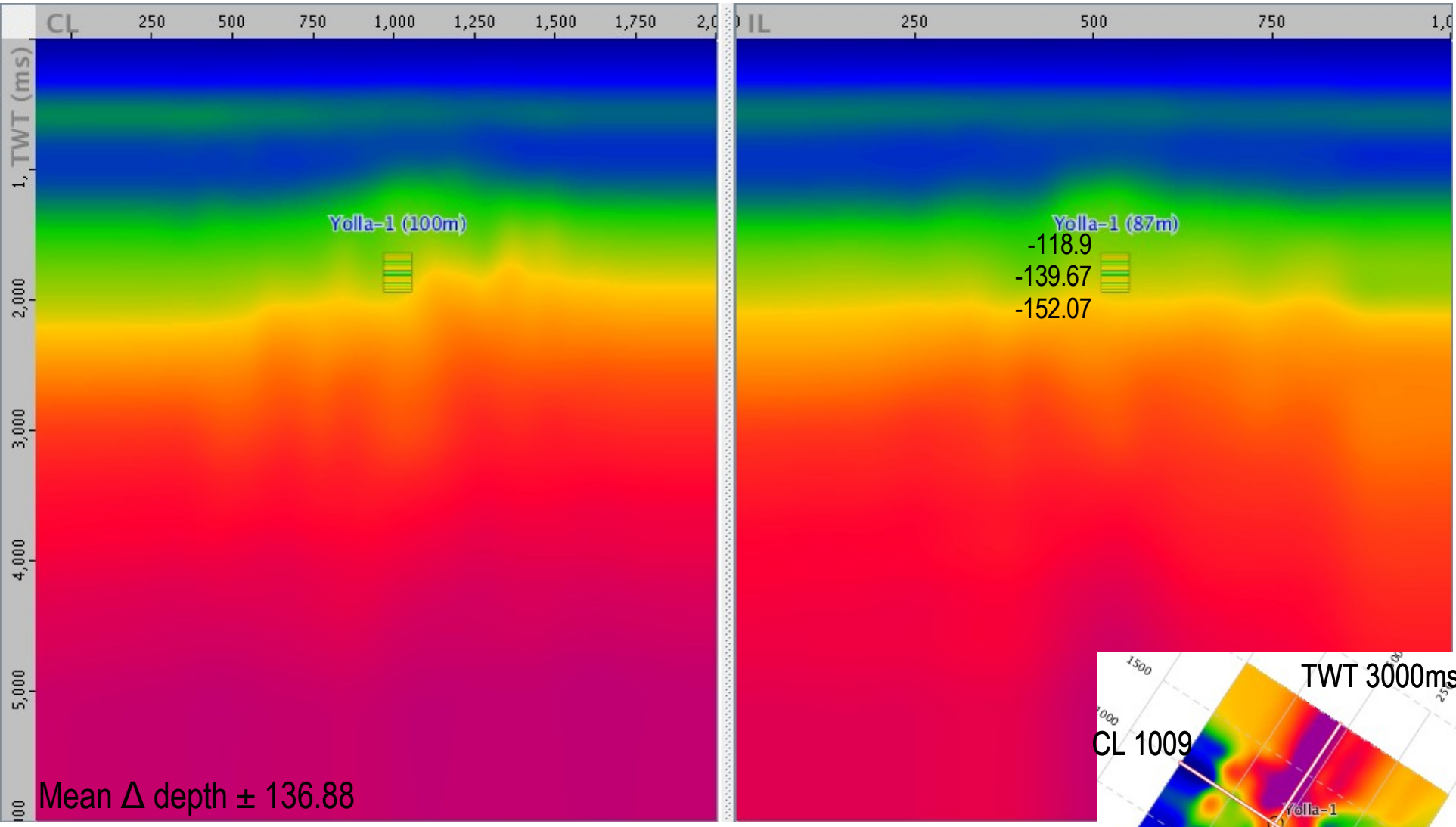
VINTT from smoothed VRMST

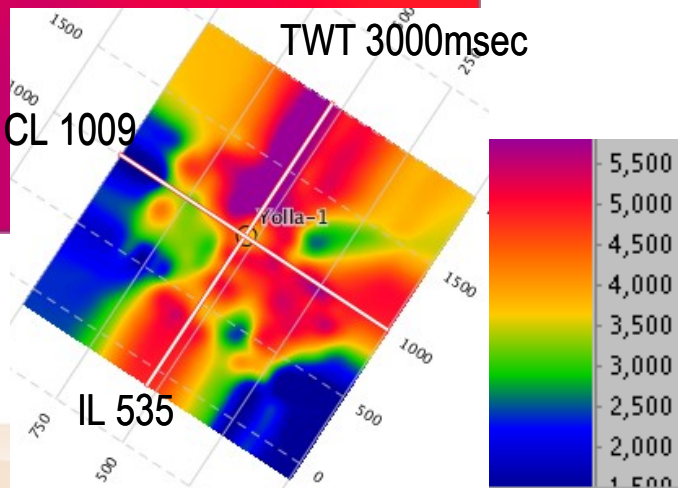




Smoothed VINTT

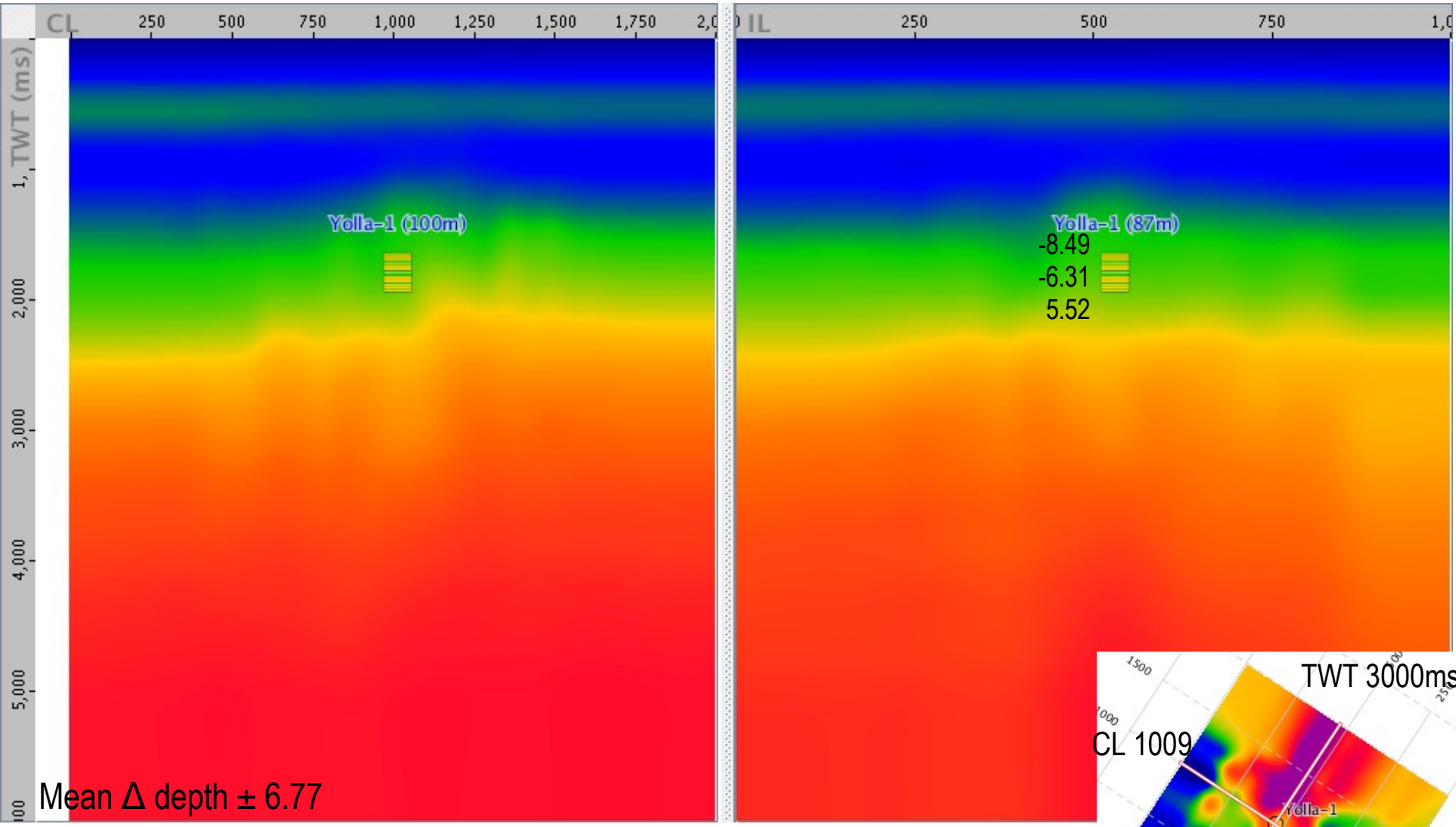
with 800m x 800m x 360msec filter



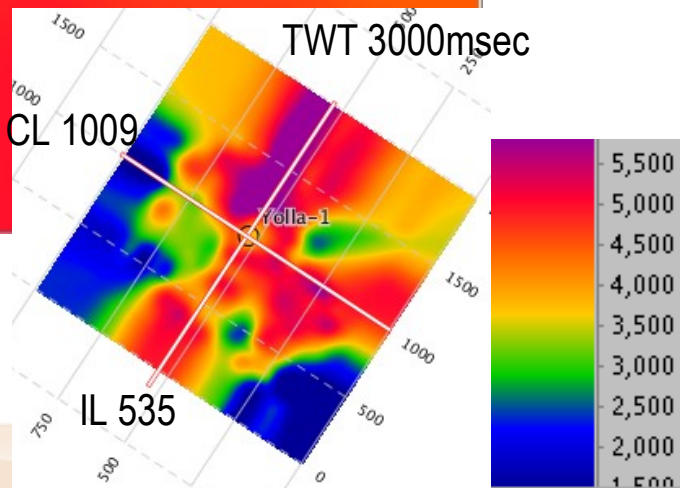


Geostatistically scaled VINTT

with depth and depth below water bottom trend

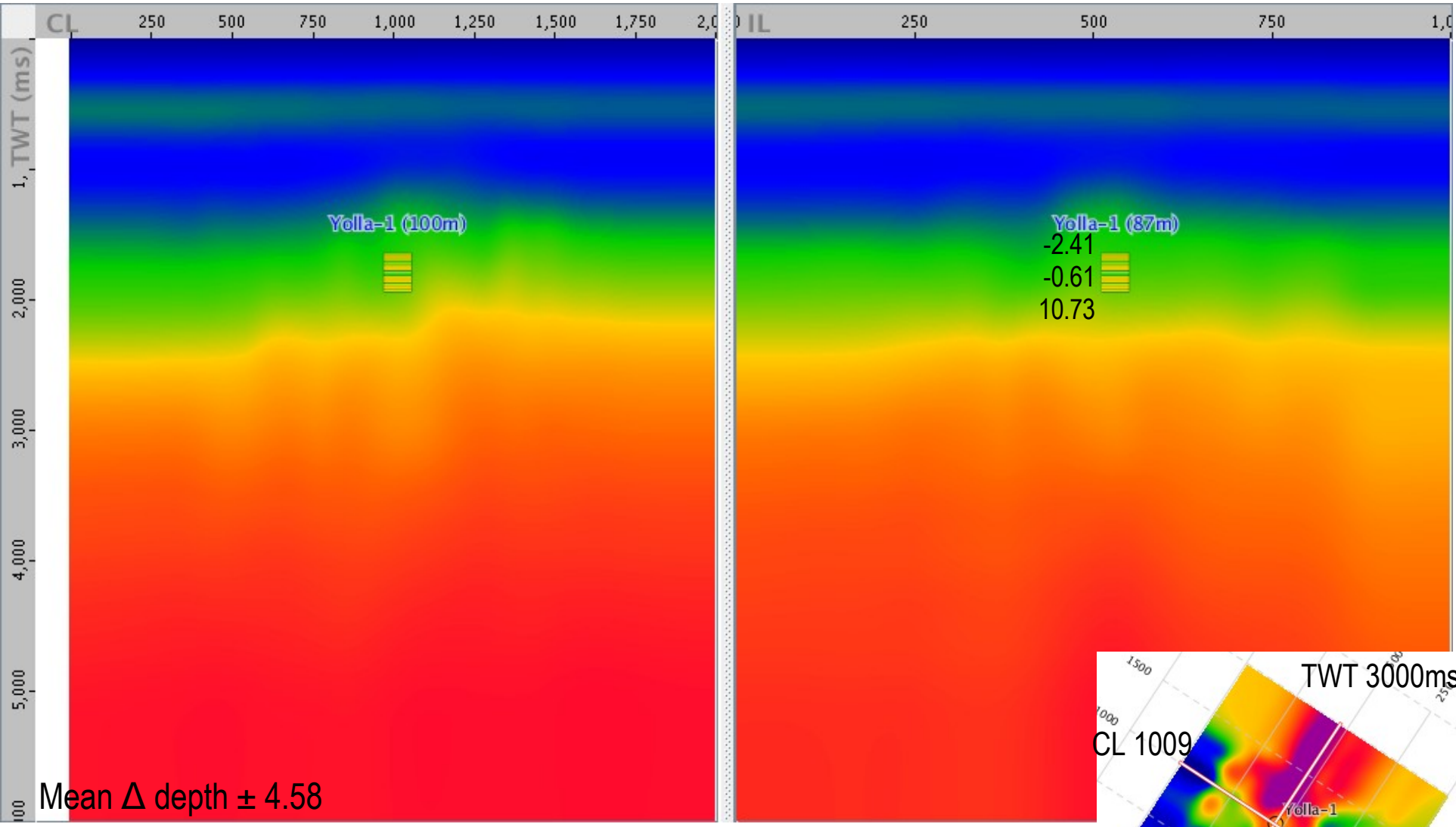


Mean Δ depth ± 6.77

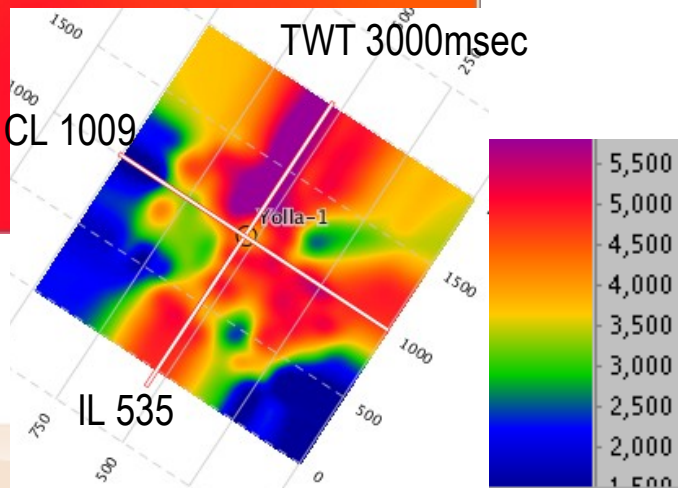


Geostatistically scaled VINTT

with depth and depth below water bottom trend; and smoothing applied

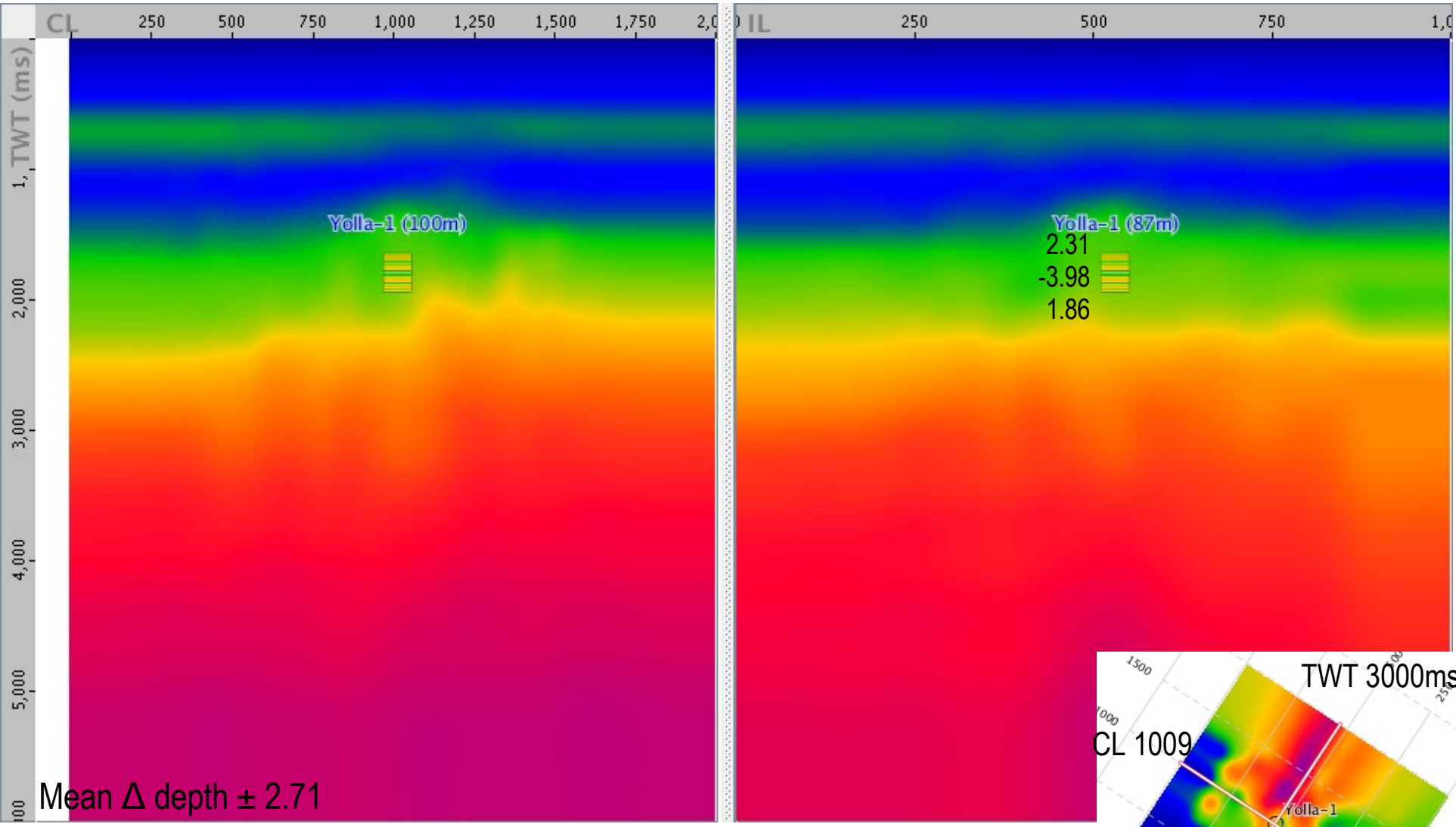


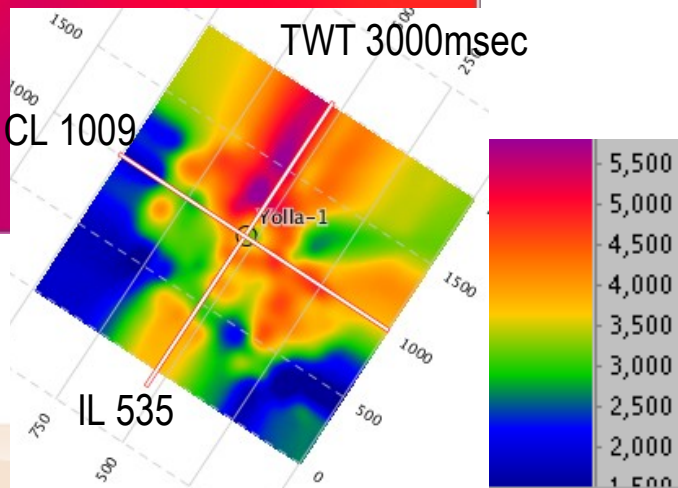
Mean Δ depth ± 4.58



Geostatistically scaled VINTT

with smoothed depth and depth below water bottom trend used as drift volume.

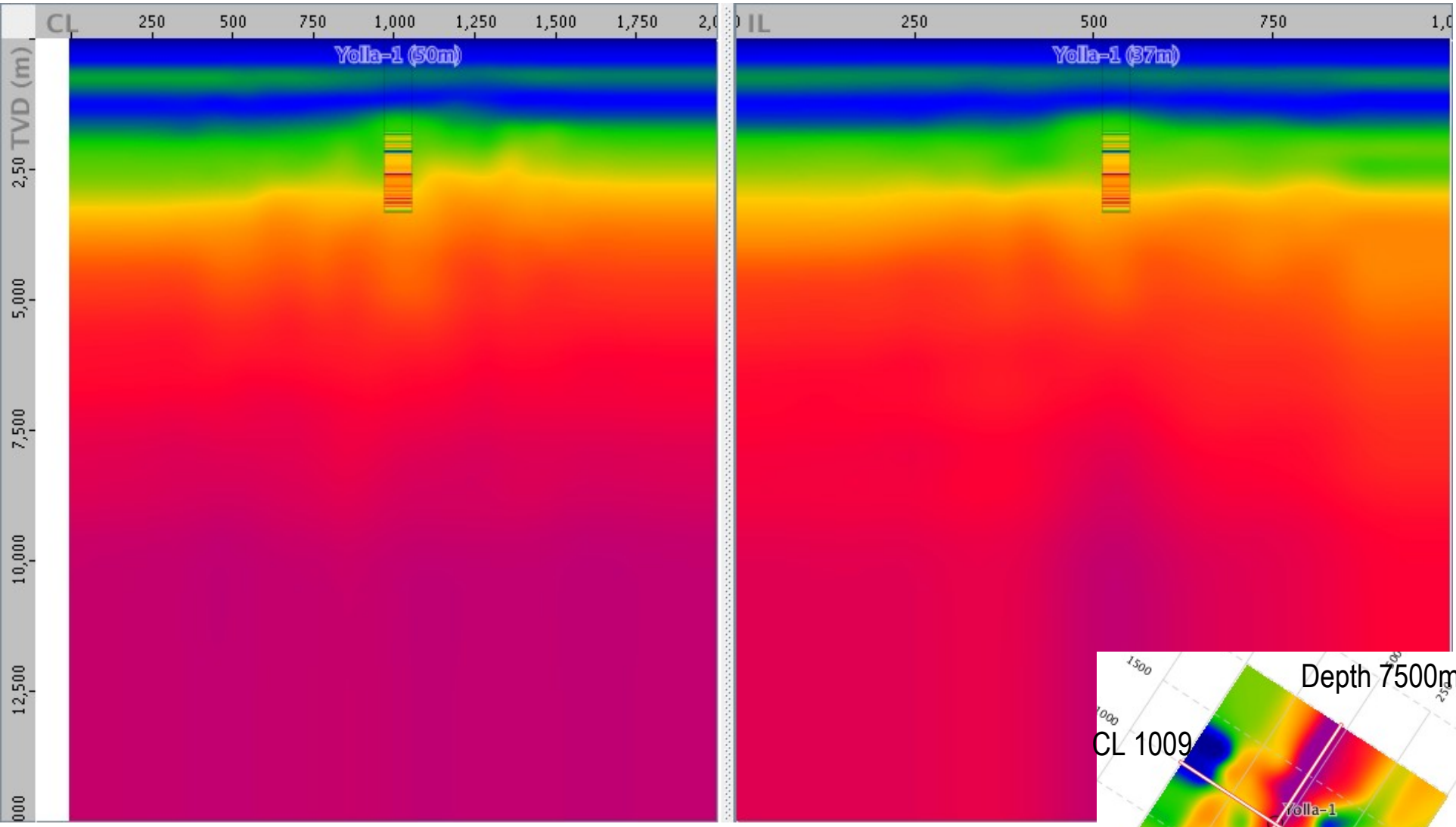


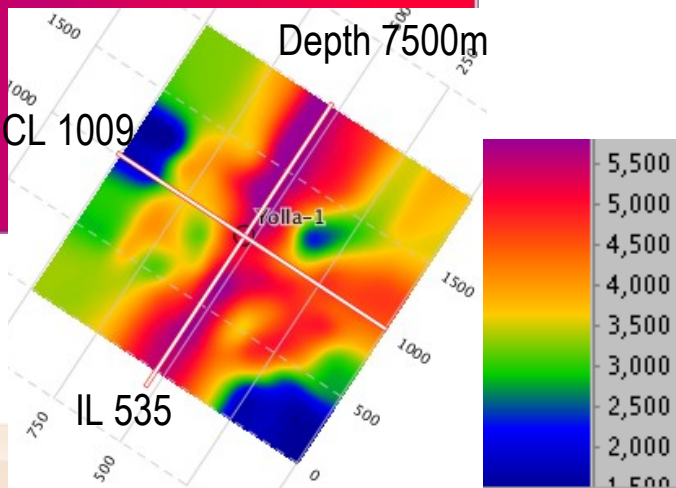


This model was chosen for the second round of migration.

VINTZ

converted from the final geostatistically scaled VINTT model





DownUnder GeoSolutions

Velocity Delta Field Preparation

1st October 2009

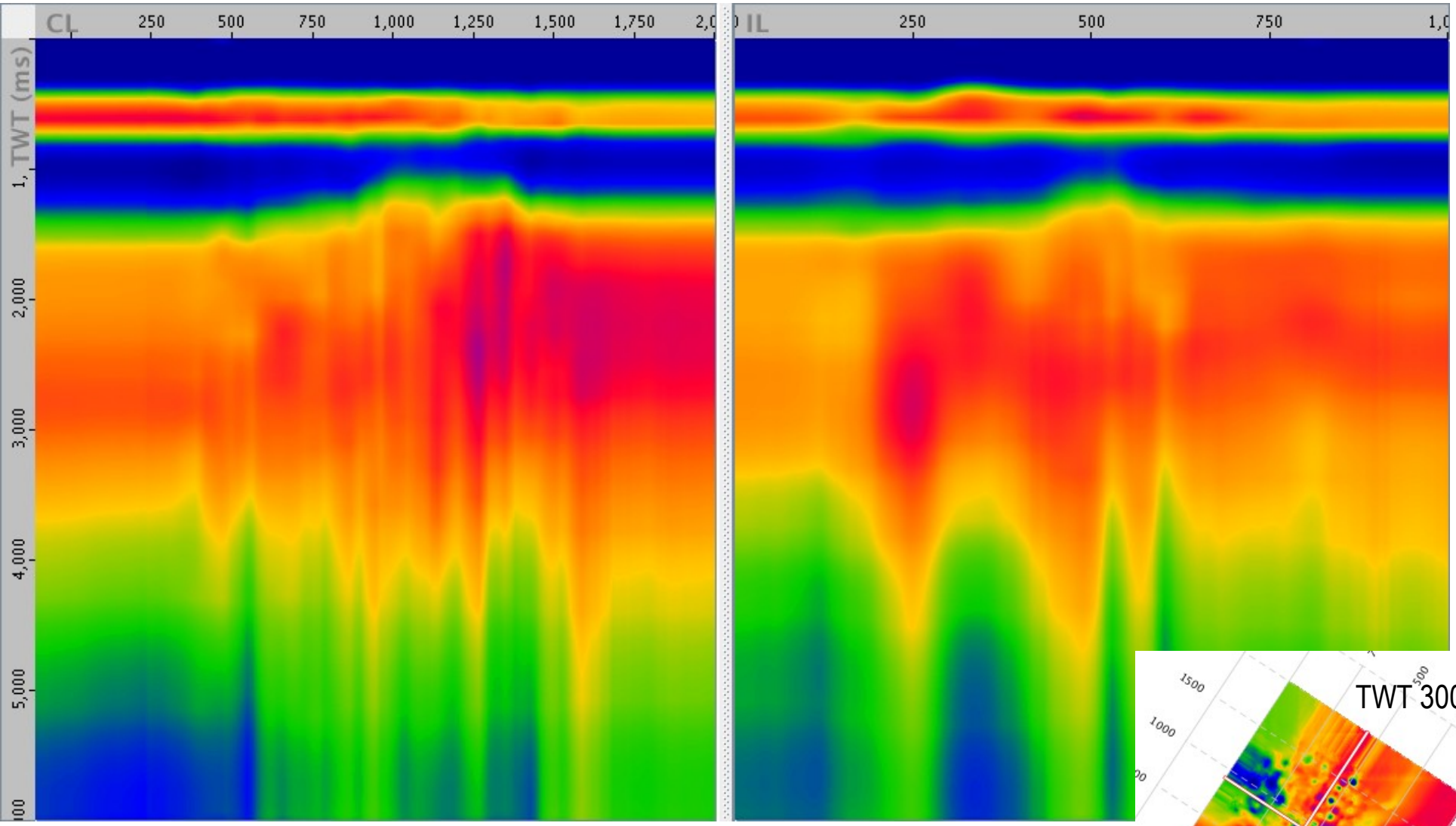
Origin Energy Resources Ltd

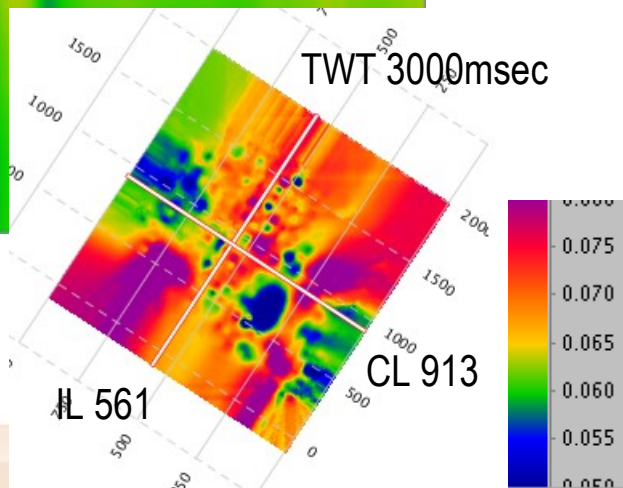
Yolla 3D Marine Seismic Survey Reprocessing

Process Flow

- A VRMST model was exported after the second round of post migration picking.
- Differences between the new VRMST model and the previous geostatistically scaled velocity (VRMST) was calculated to get the delta field.
- Smoothing applied on the delta field. The smoothed delta field was converted to depth using geostatistically scaled velocity (VINTZ).
- Different scale applied to delta field to output different epsilons.

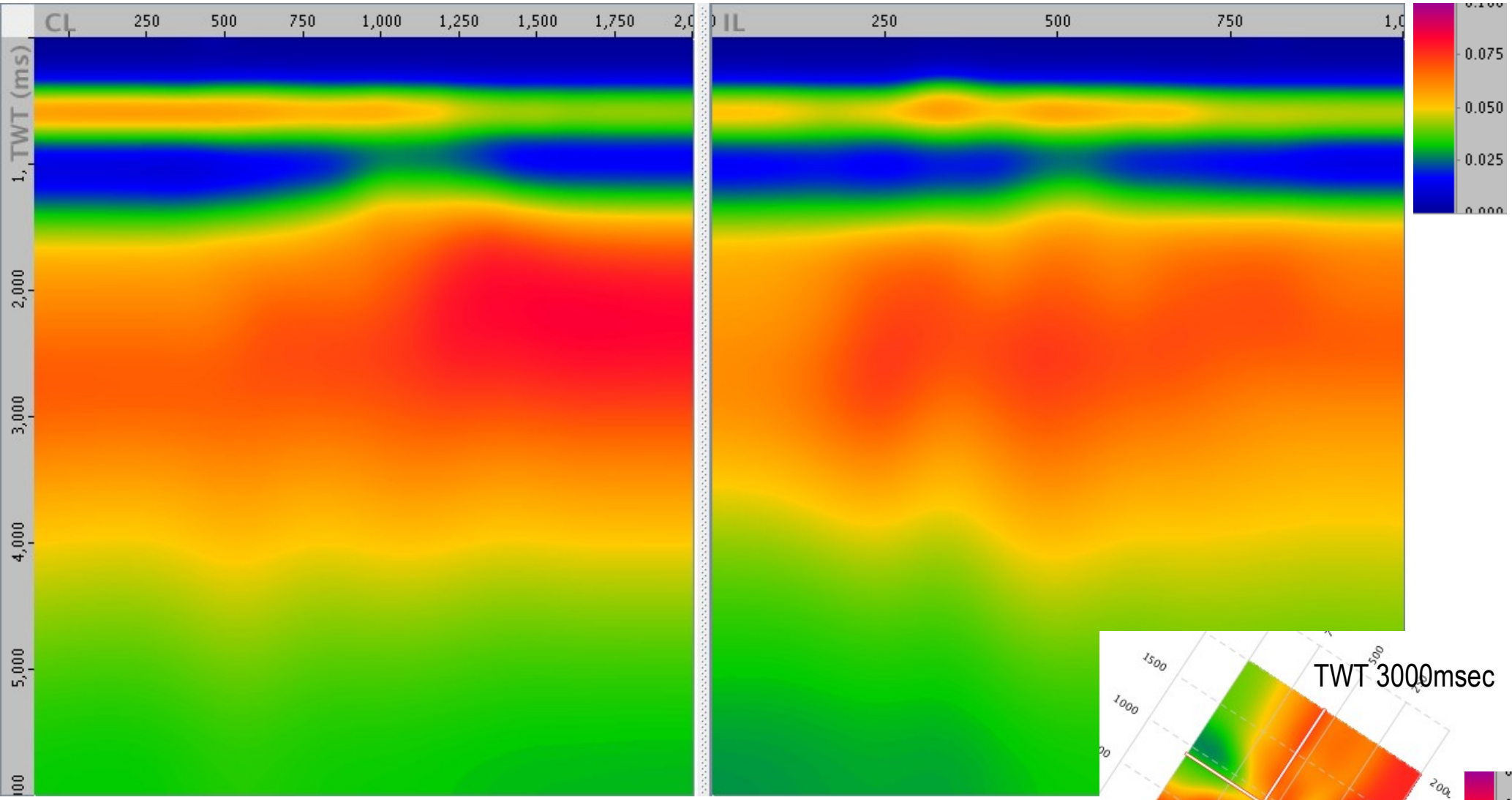
Delta field in time domain

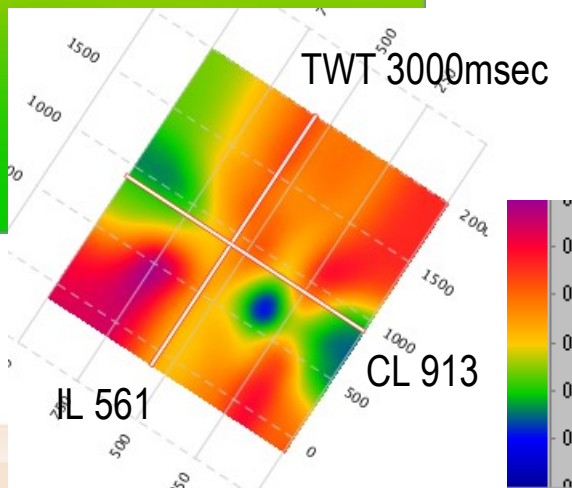




Smoothed delta field

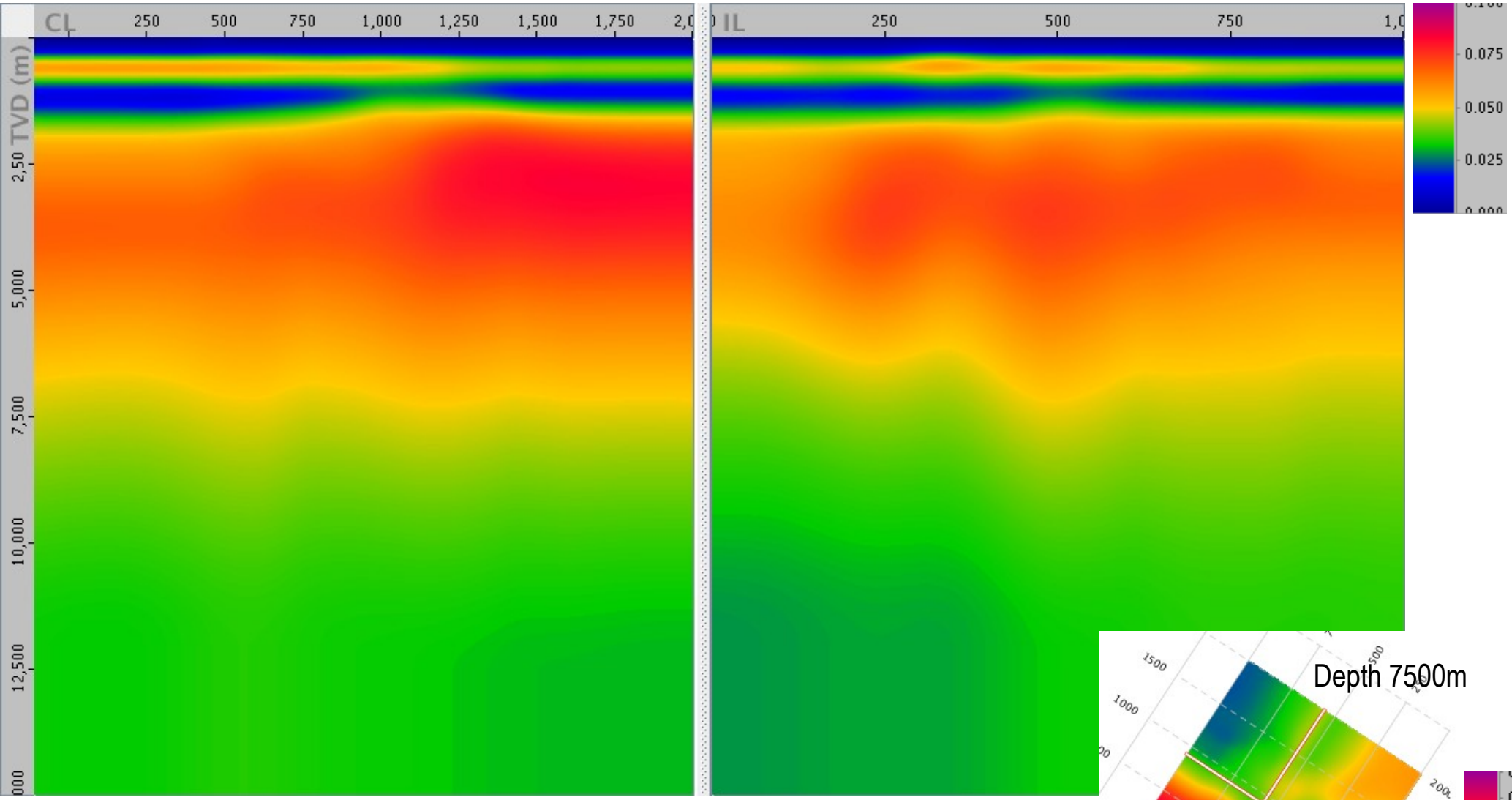
with 2400m x 2400m x 480msec filter

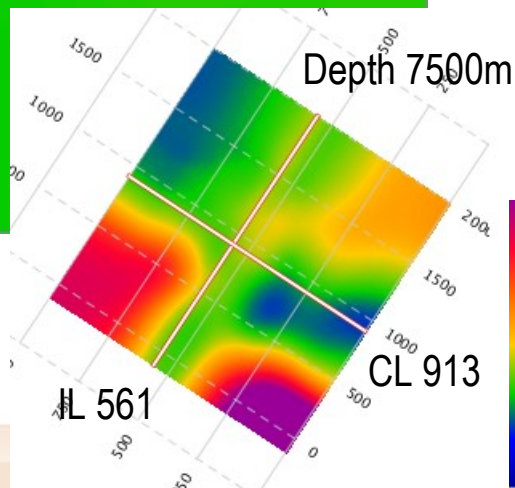




Delta field in depth

converted to depth using the geostatistically scaled velocity





DownUnder GeoSolutions

Tomography Velocity Update

22nd October 2009

Origin Energy Resources Ltd

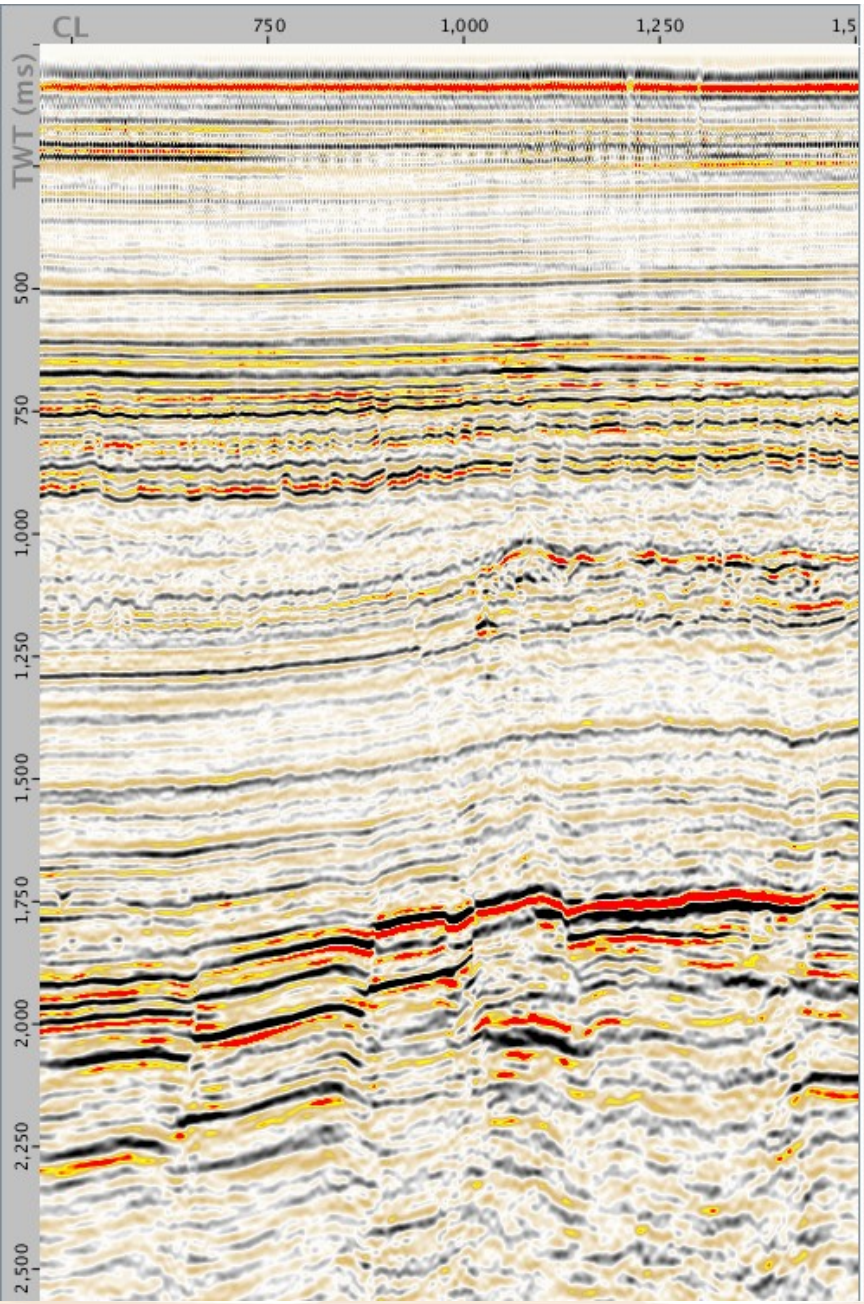
Yolla 3D Marine Seismic Survey Reprocessing

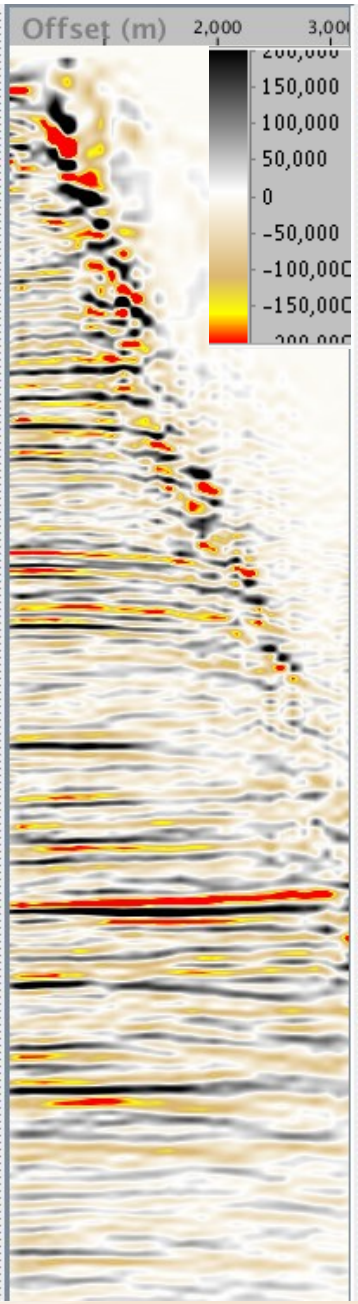
Summary

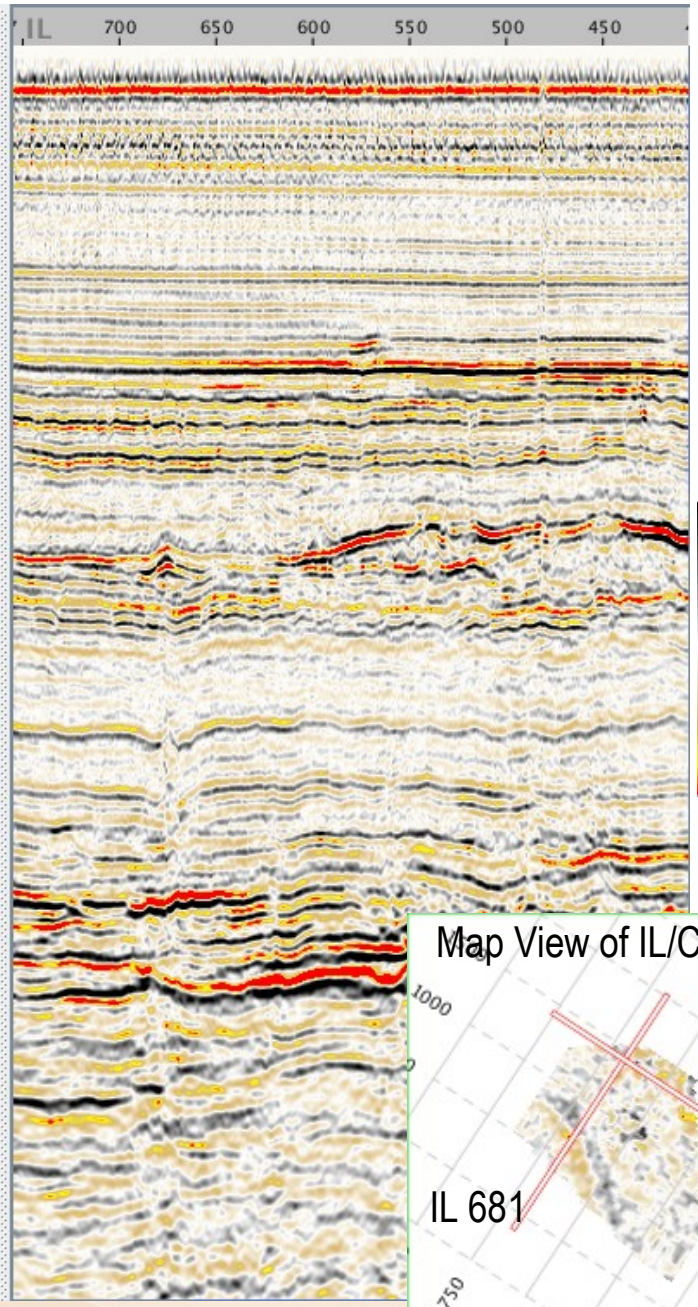
- A problem was identified with the initial tomographic updates. The gathers used to pick the anisotropic migration parameter were on a 500 x 500m grid. During tomography the cell sizes were much smaller which meant that some cells had no rays passing through them. This caused a footprint in the updates which resulted in oscillations in some events after depth conversion. These variations in velocities were very small.
- The output from the 2nd tomographic update migration was reduced to 50x50m with smaller scale lengths in mind for subsequent updates. It was decided to re-migrate this update with the errors corrected for in the velocity field.
- This removed the oscillations in events and is now being picked for the 3rd update.

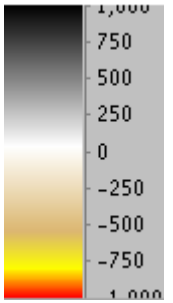
Anisotropic migration gathers and stacks

at IL 681, CL 1421







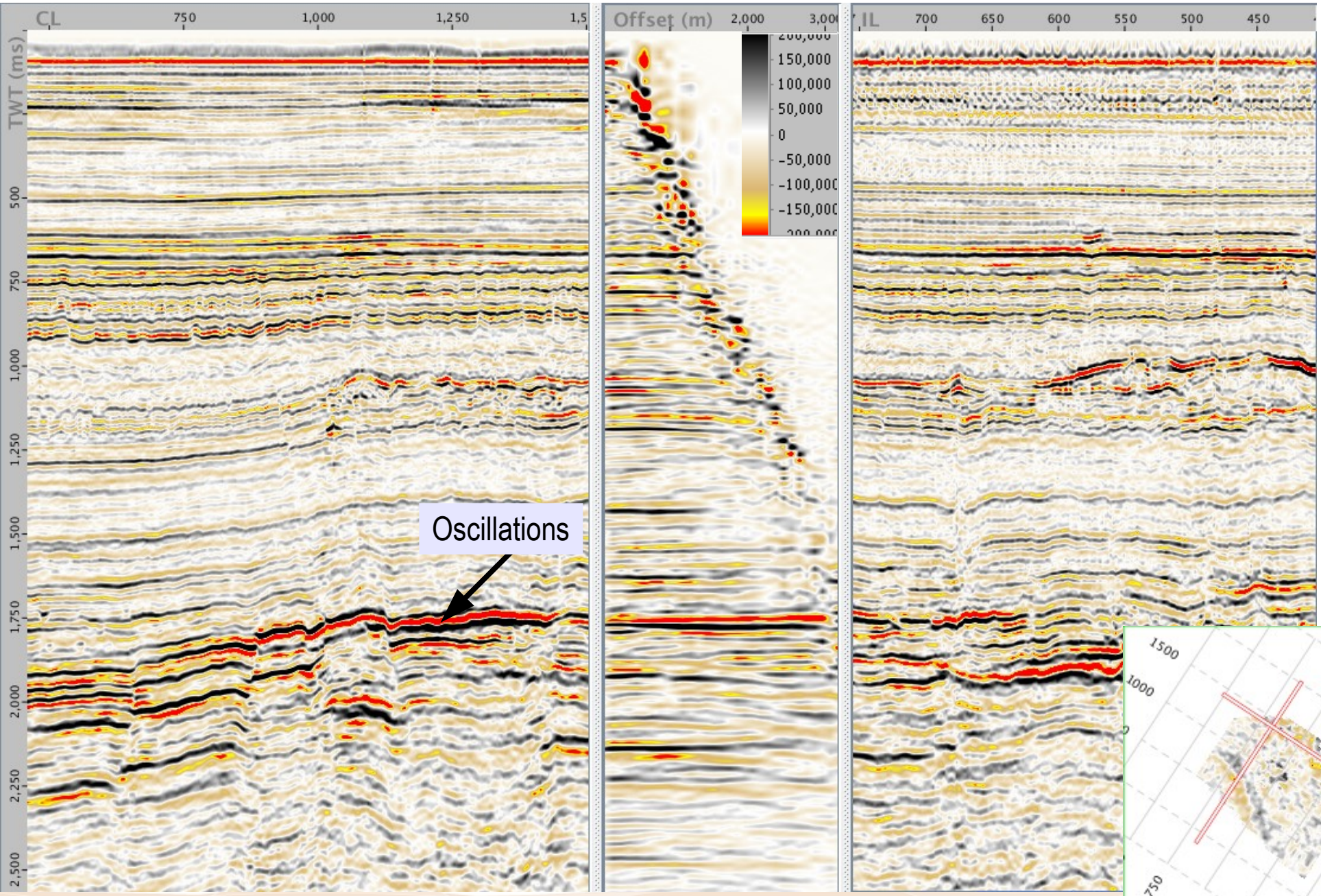


Stack colour bar

Map View of IL/CL location

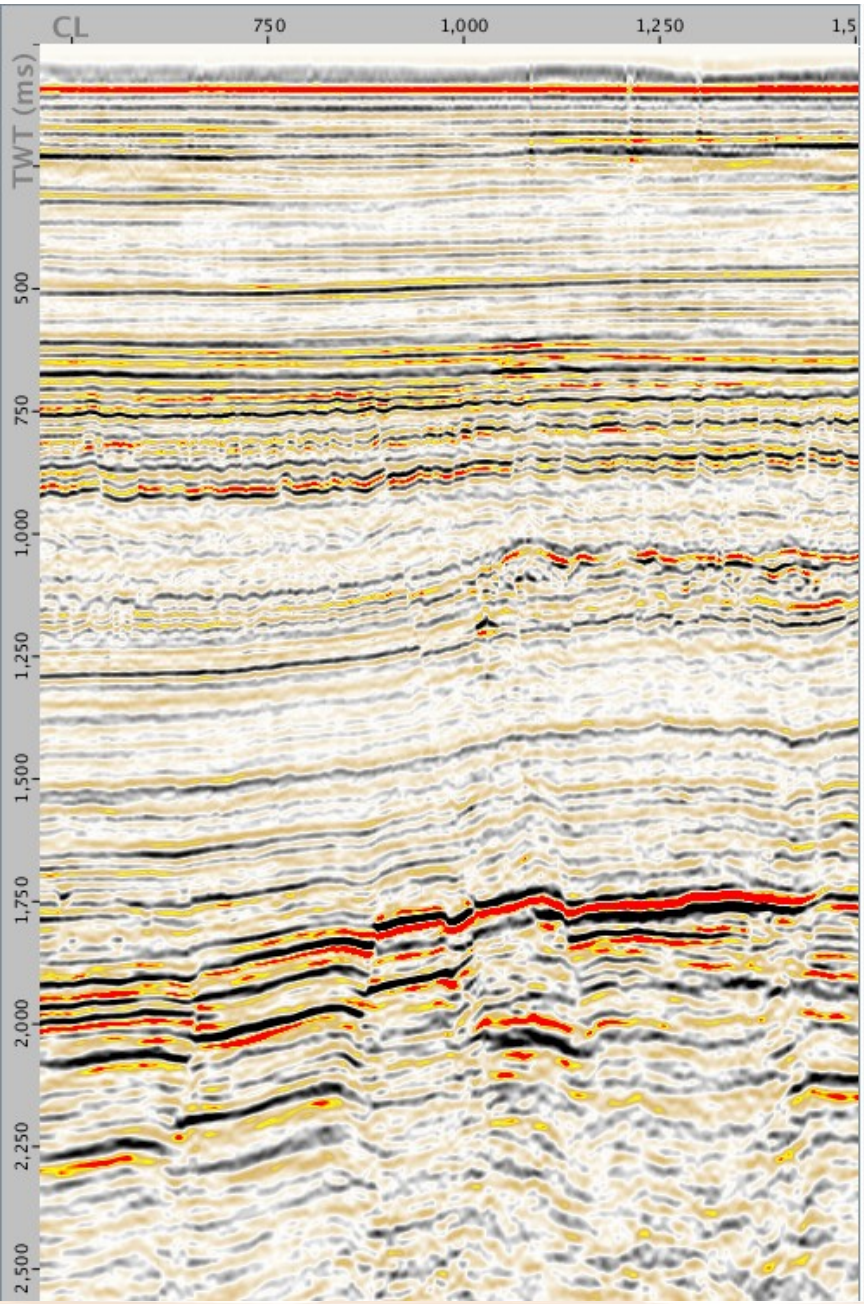
2nd Tomography migration gathers & stacks

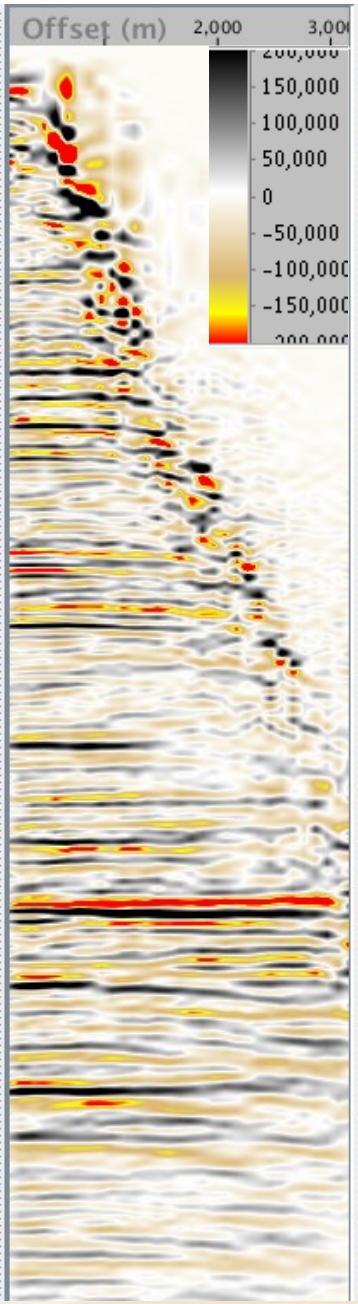
at IL 681, CL 1421

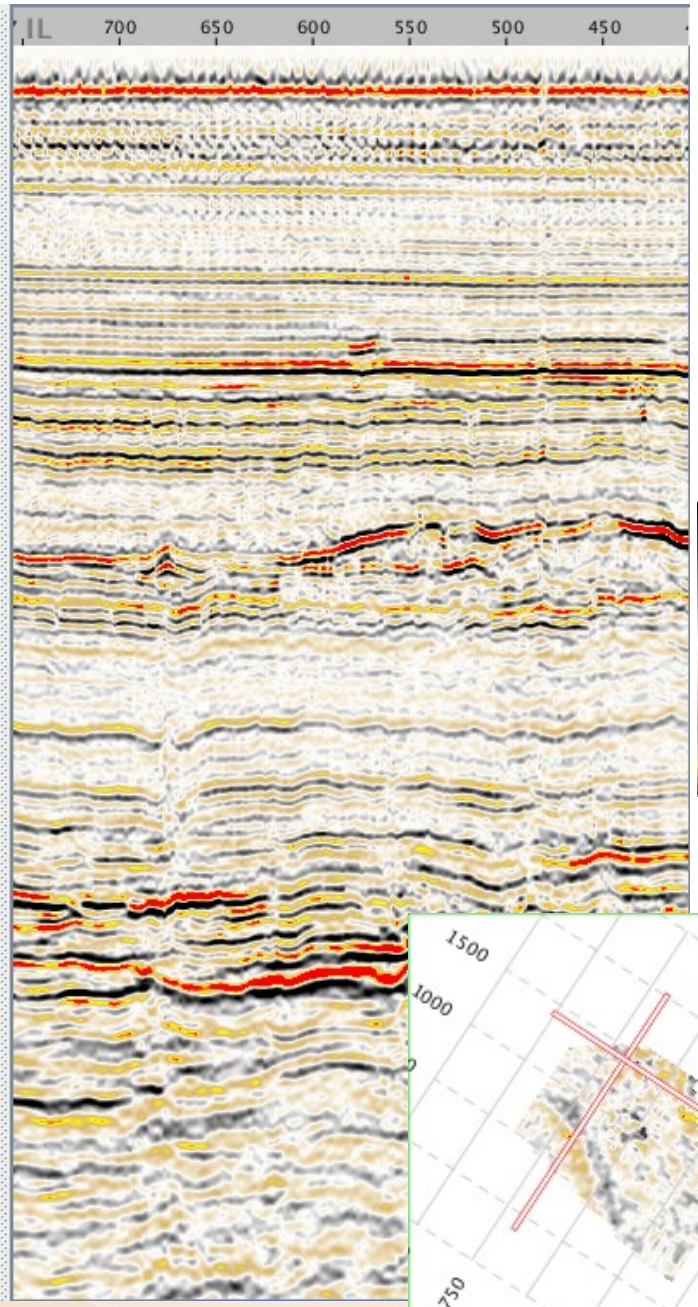


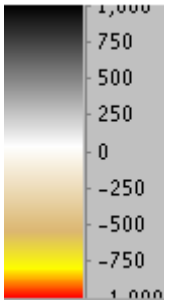
Fixed 2nd Tomography migration gathers & stacks

at IL 681, CL 1421





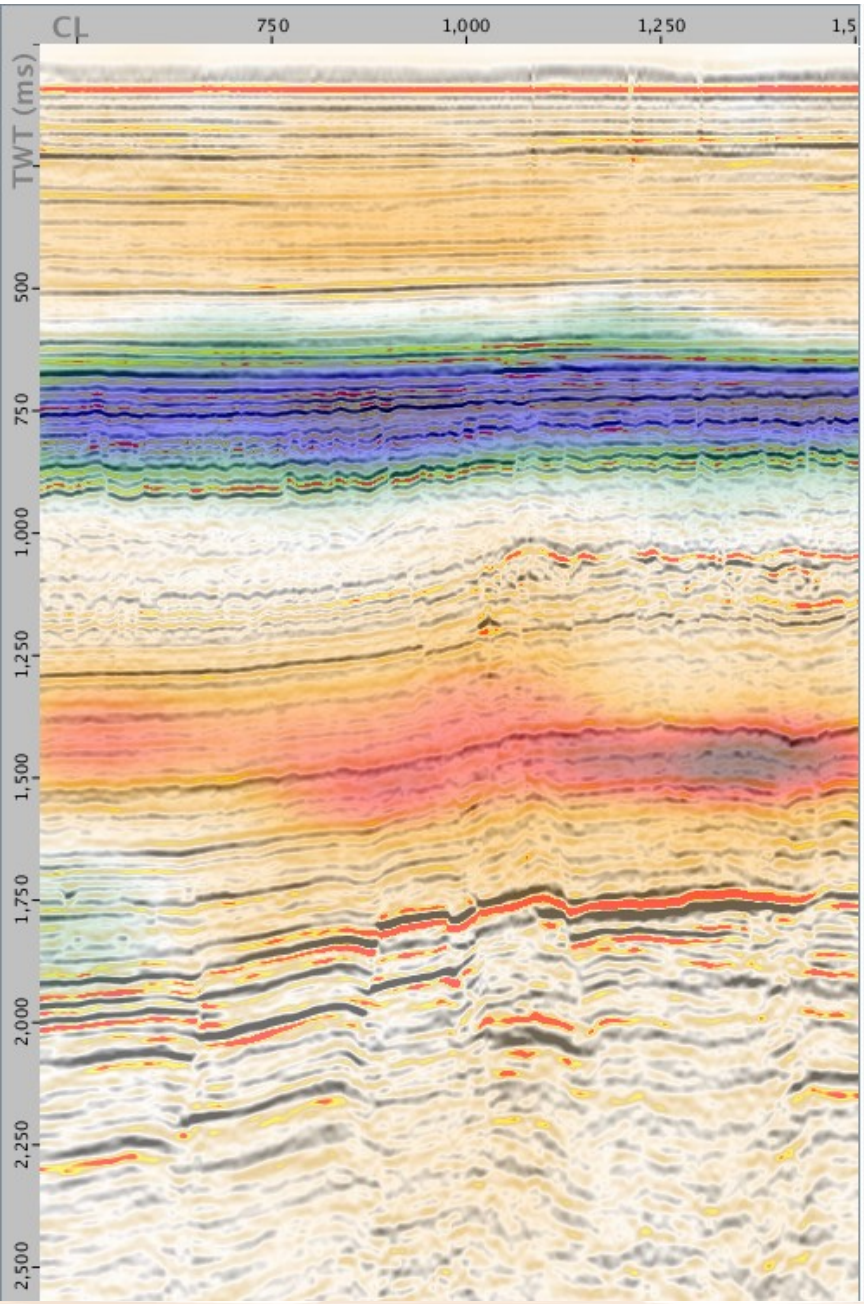


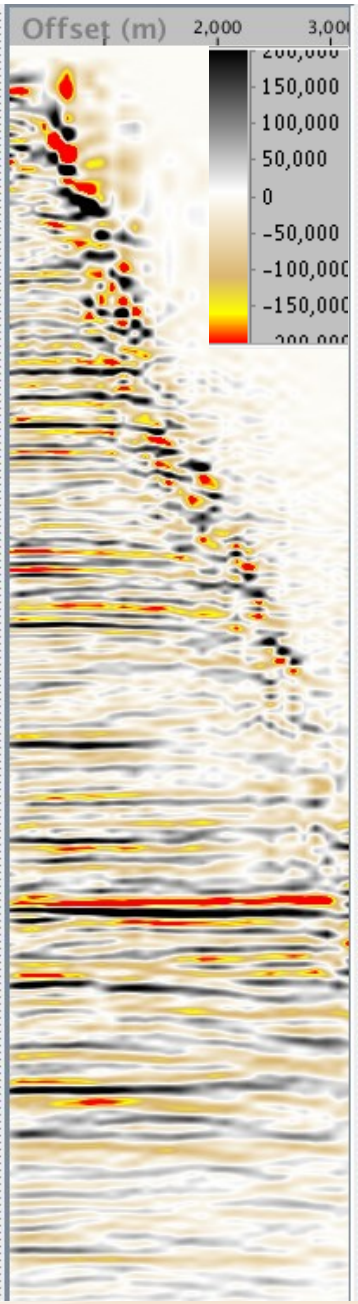


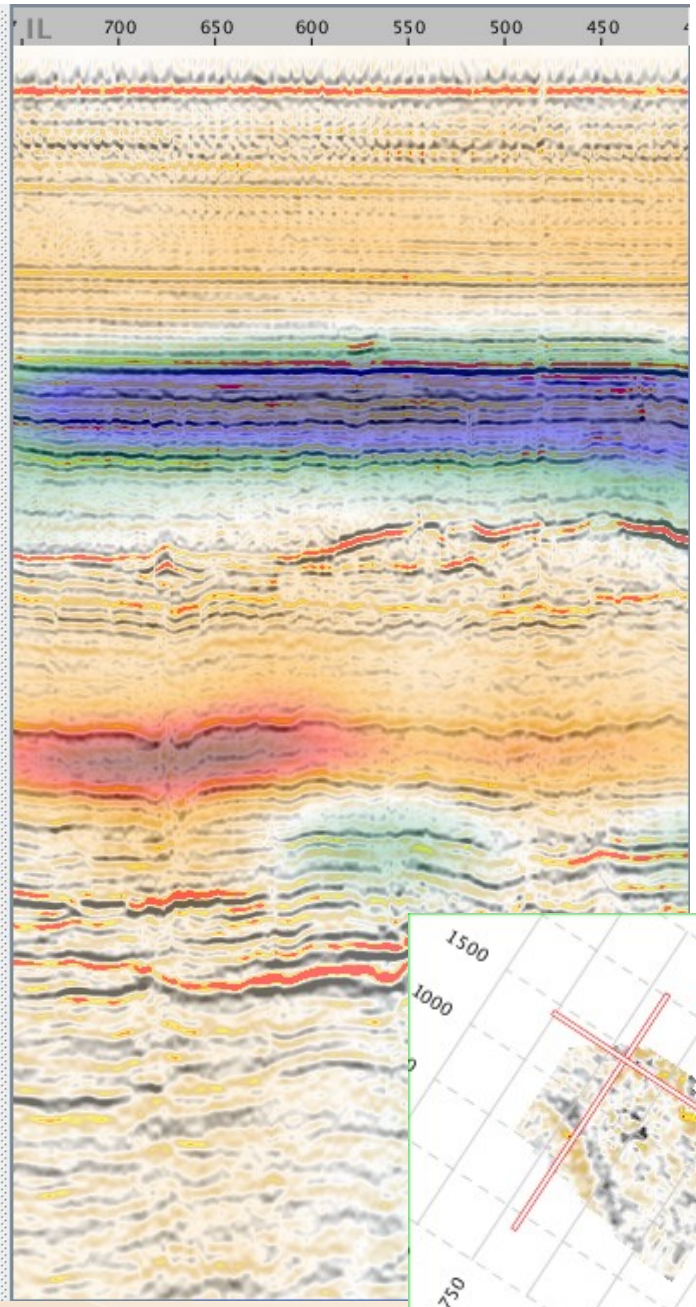
Stack colour bar

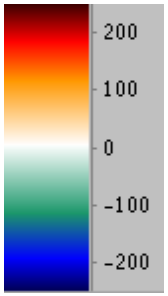
Fixed 2nd Tomography migration gathers &stacks

at IL 681, CL 1421 with velocity update (1+2) overlain

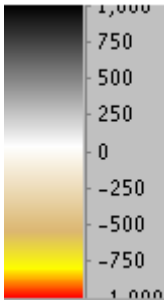








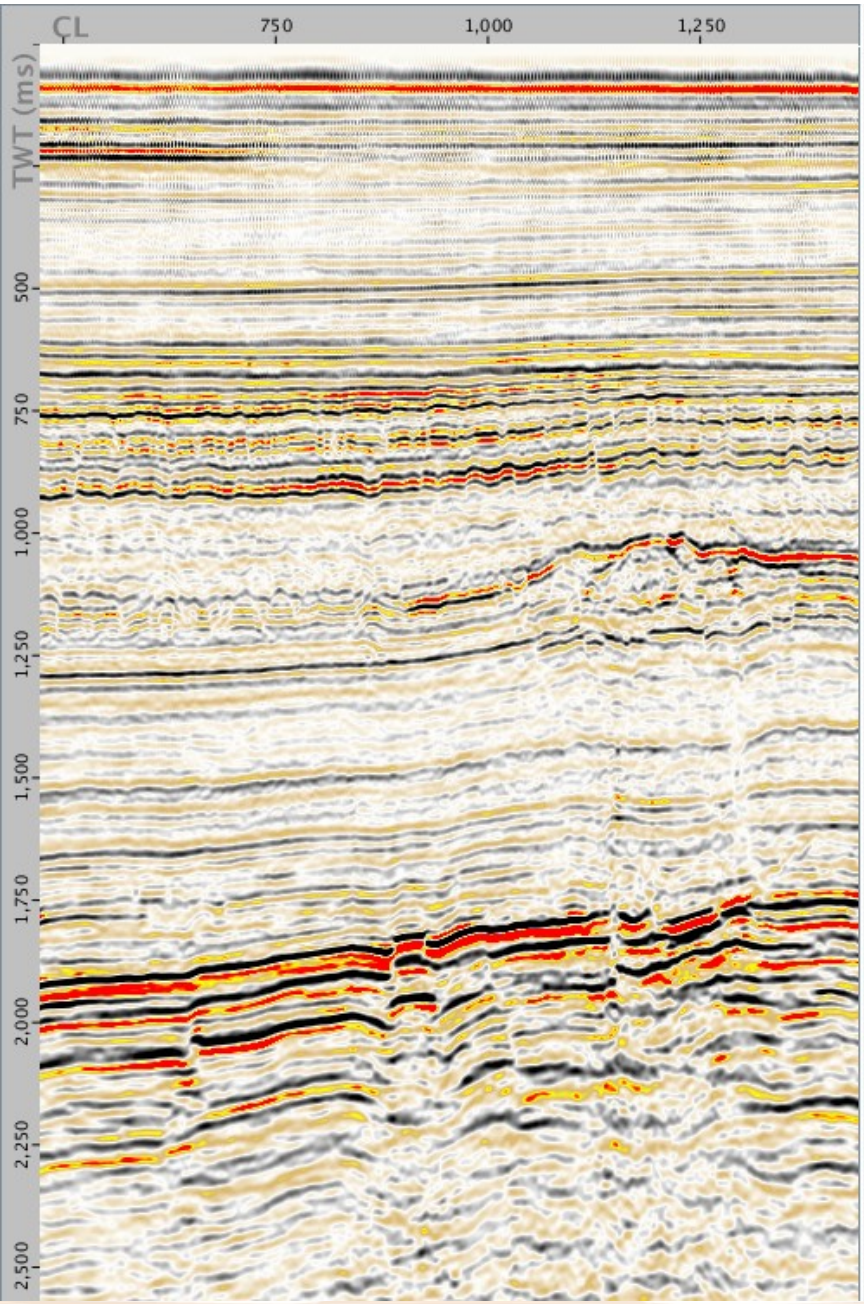
Velocity update colour bar

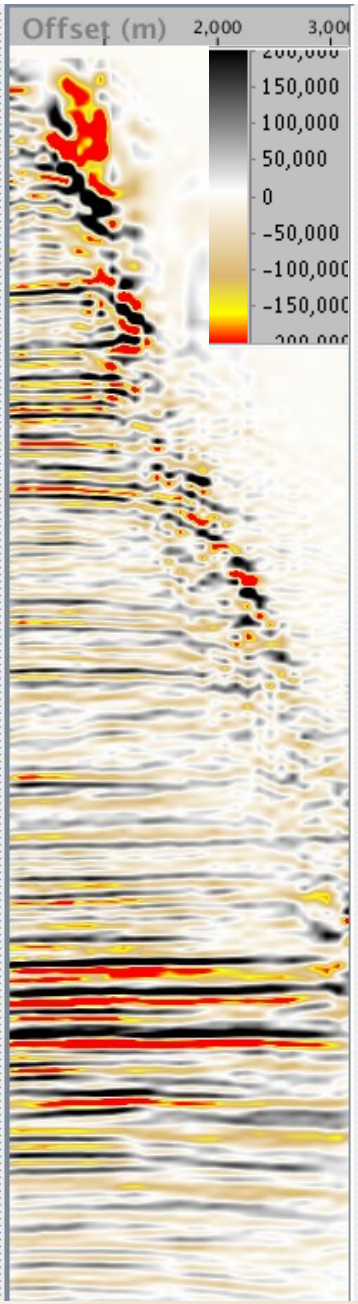


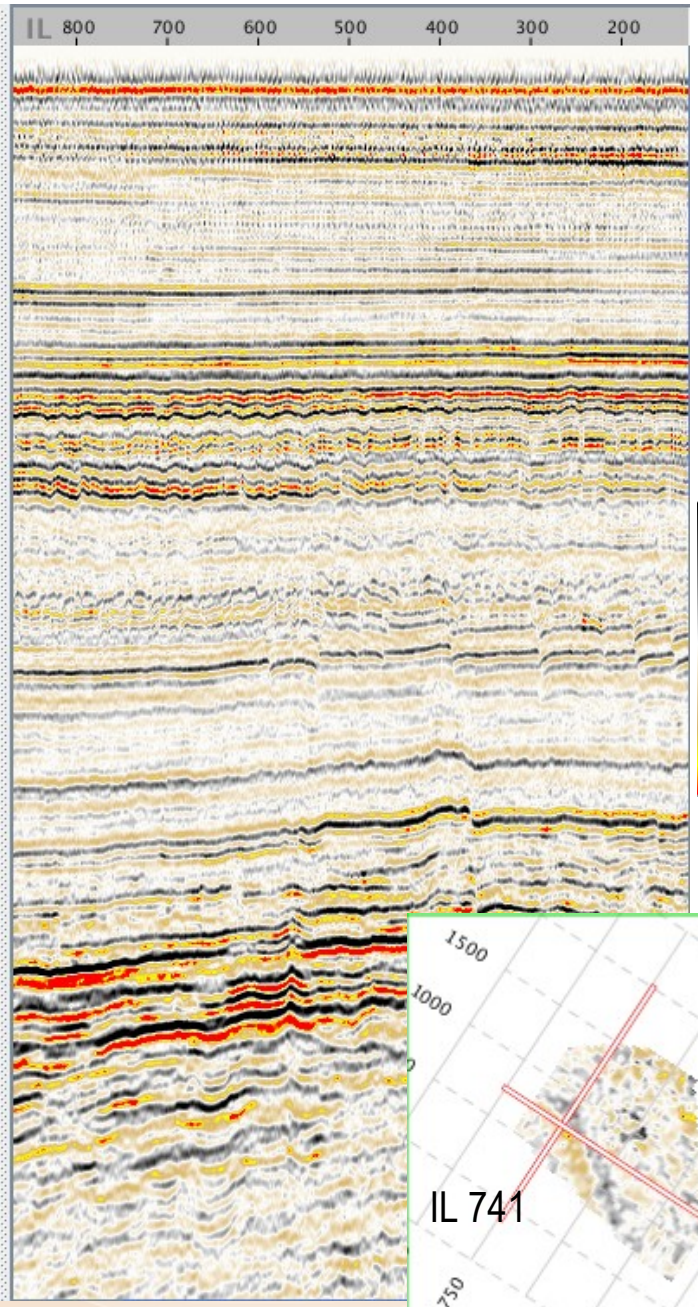
Stack colour bar

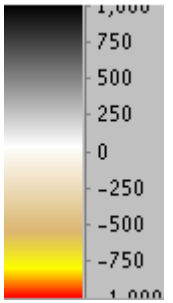
Anisotropic migration gathers and stacks

at IL 741, CL 741





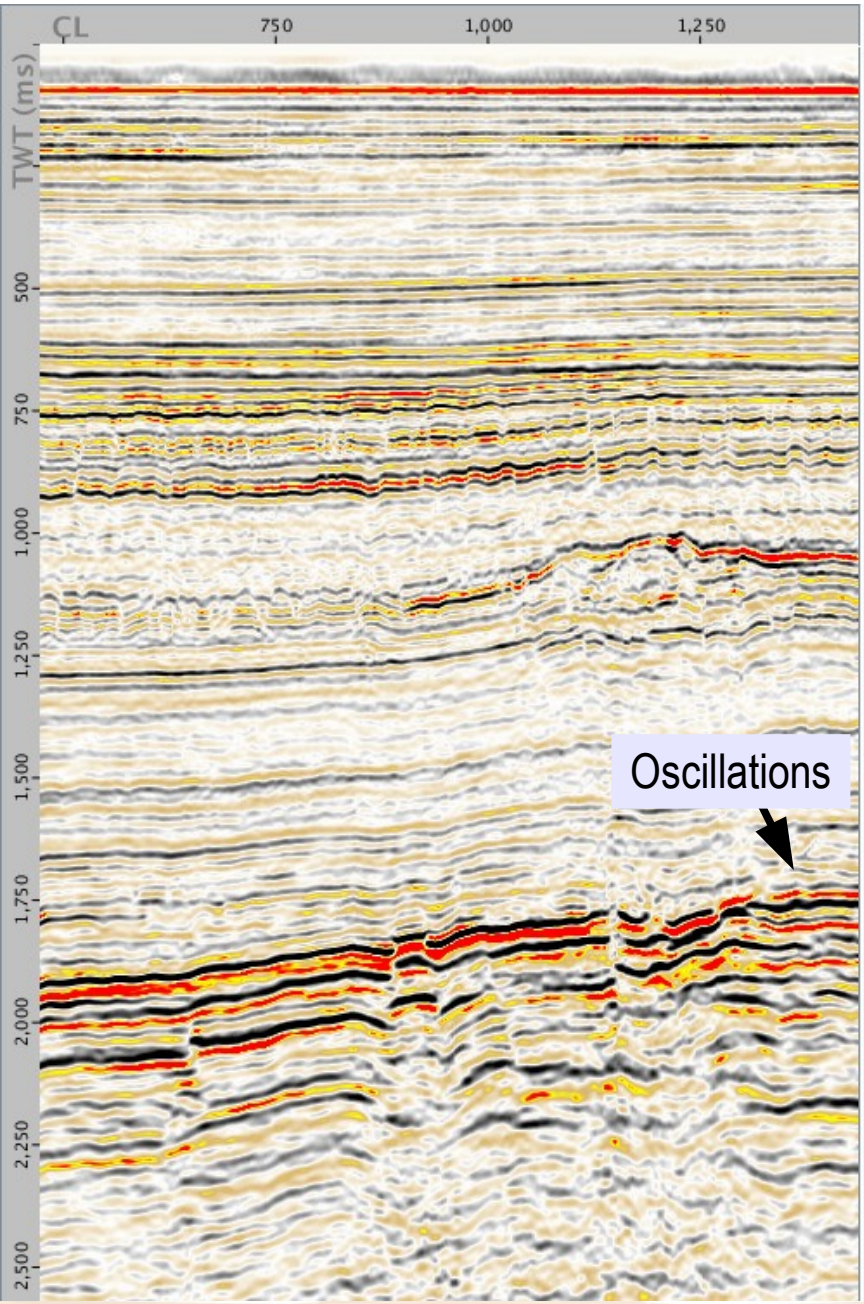


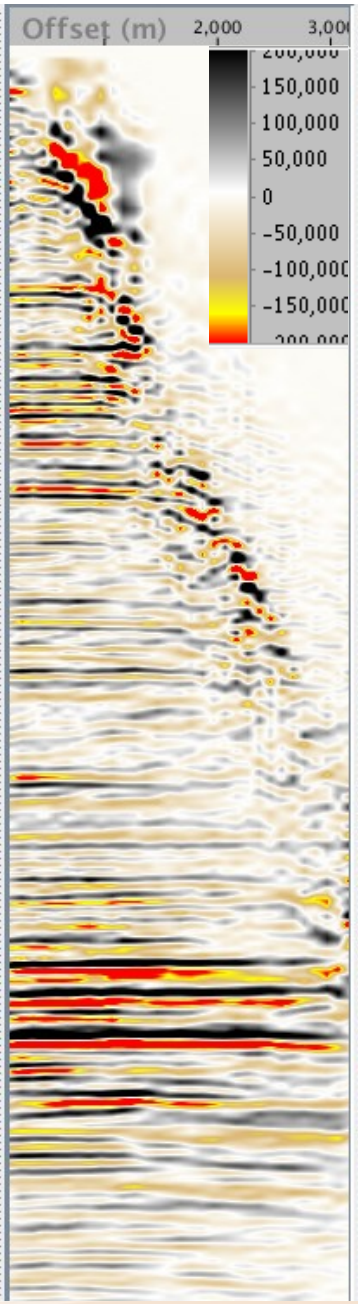


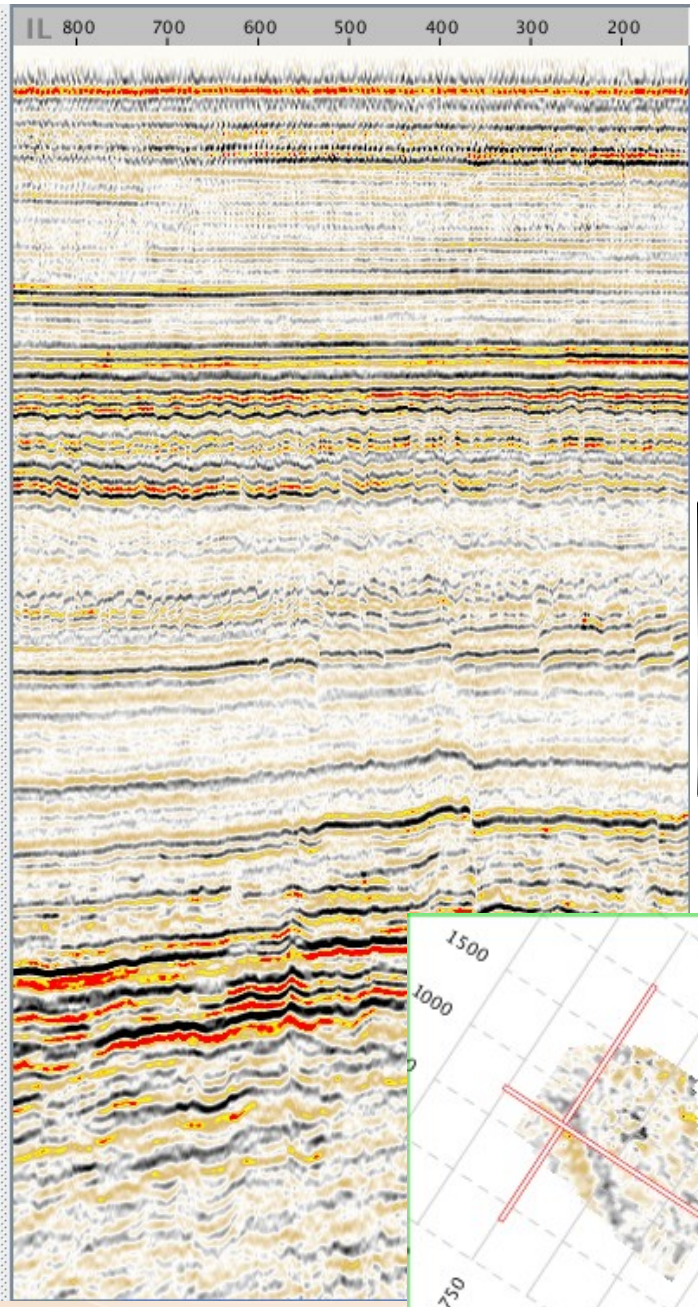
Stack colour bar

2nd Tomography migration gathers & stacks

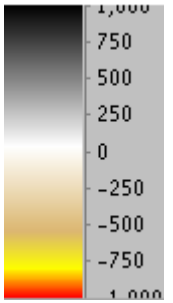
at IL 741, CL 741







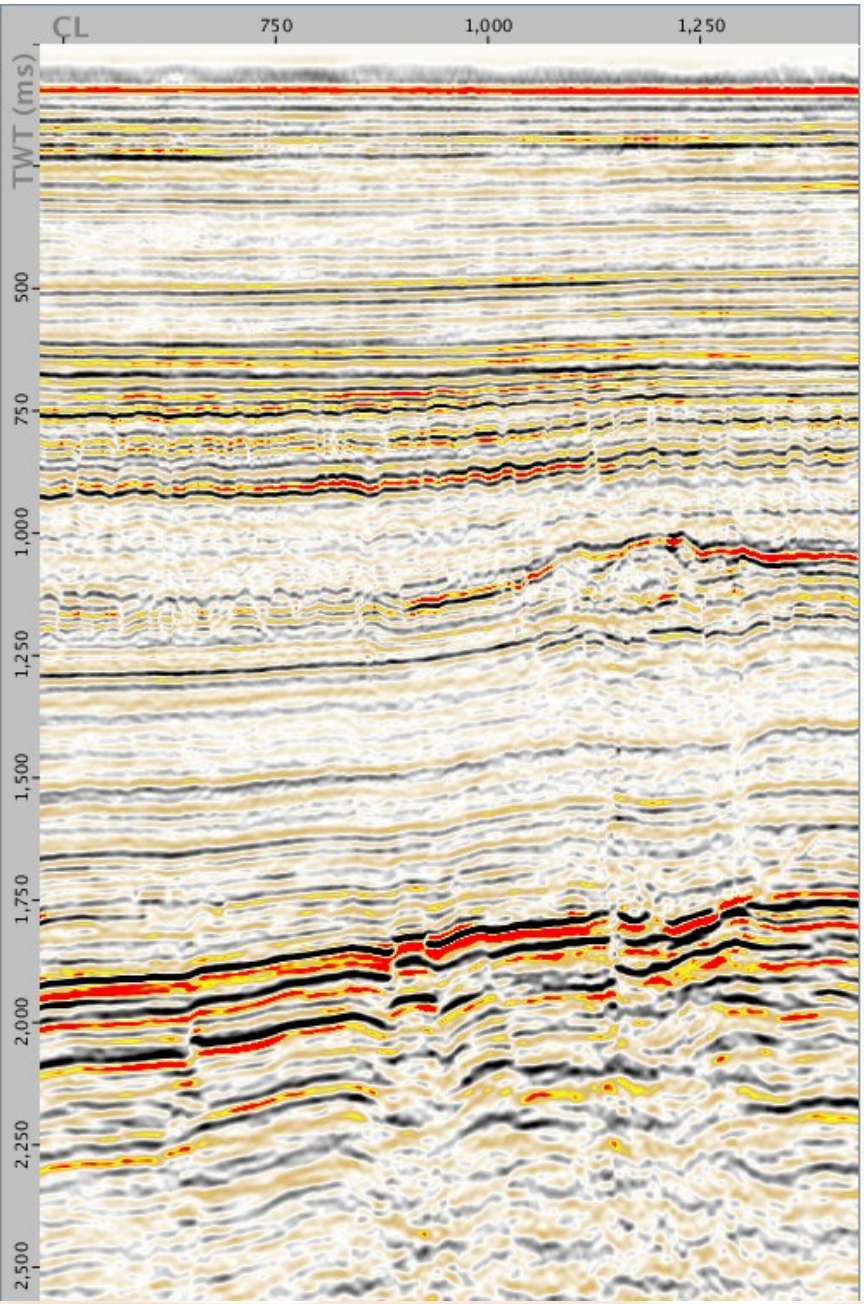
Oscillations

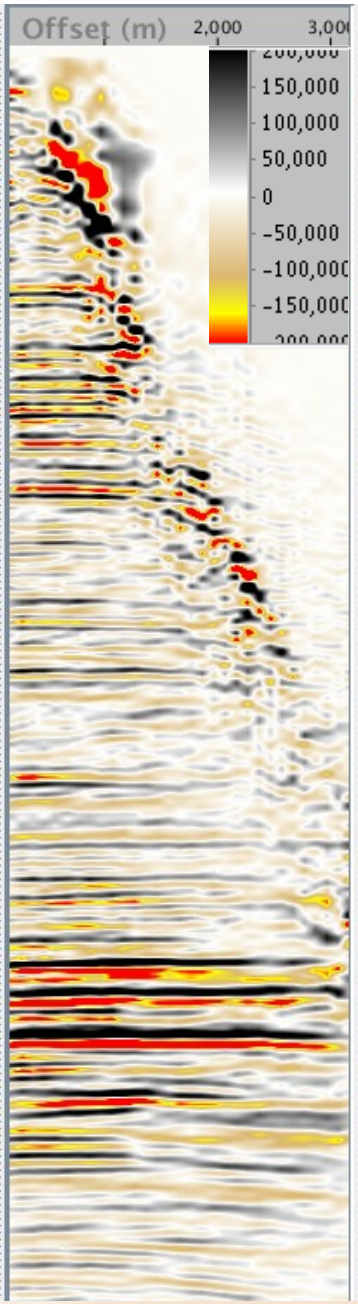


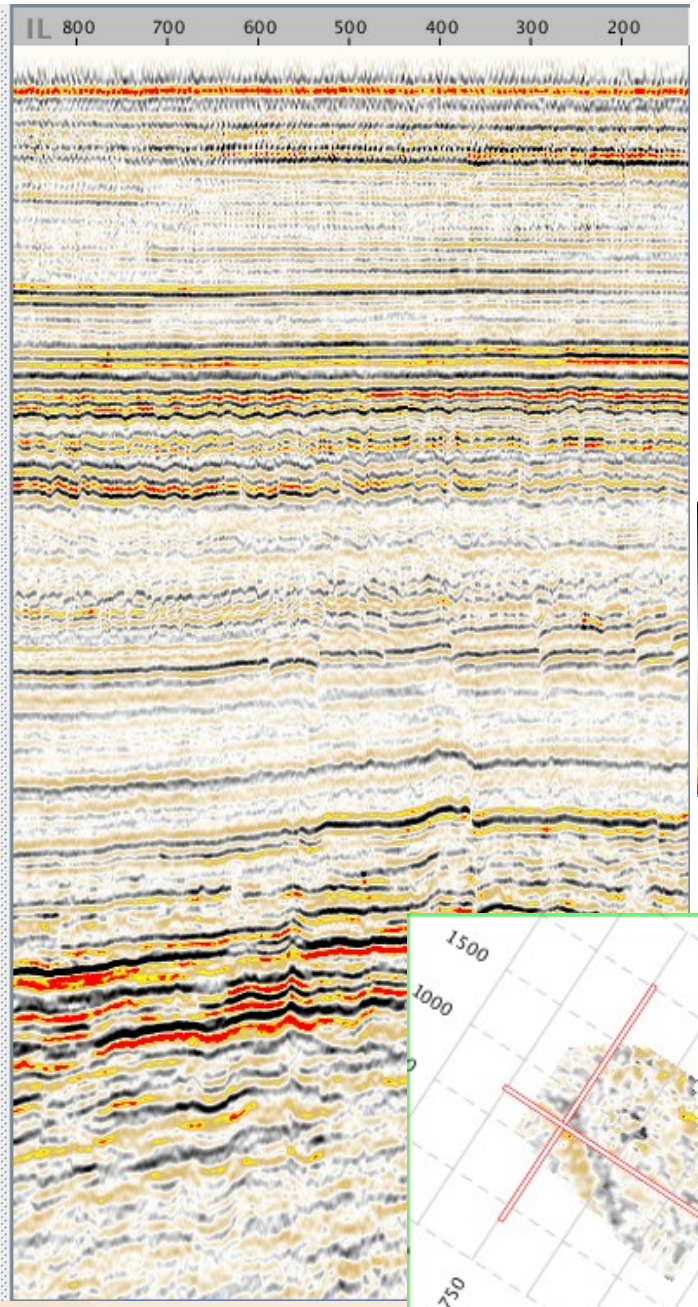
Stack colour bar

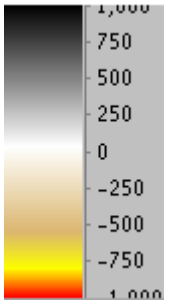
Fixed 2nd Tomography migration gathers & stacks

at IL 741, CL 741





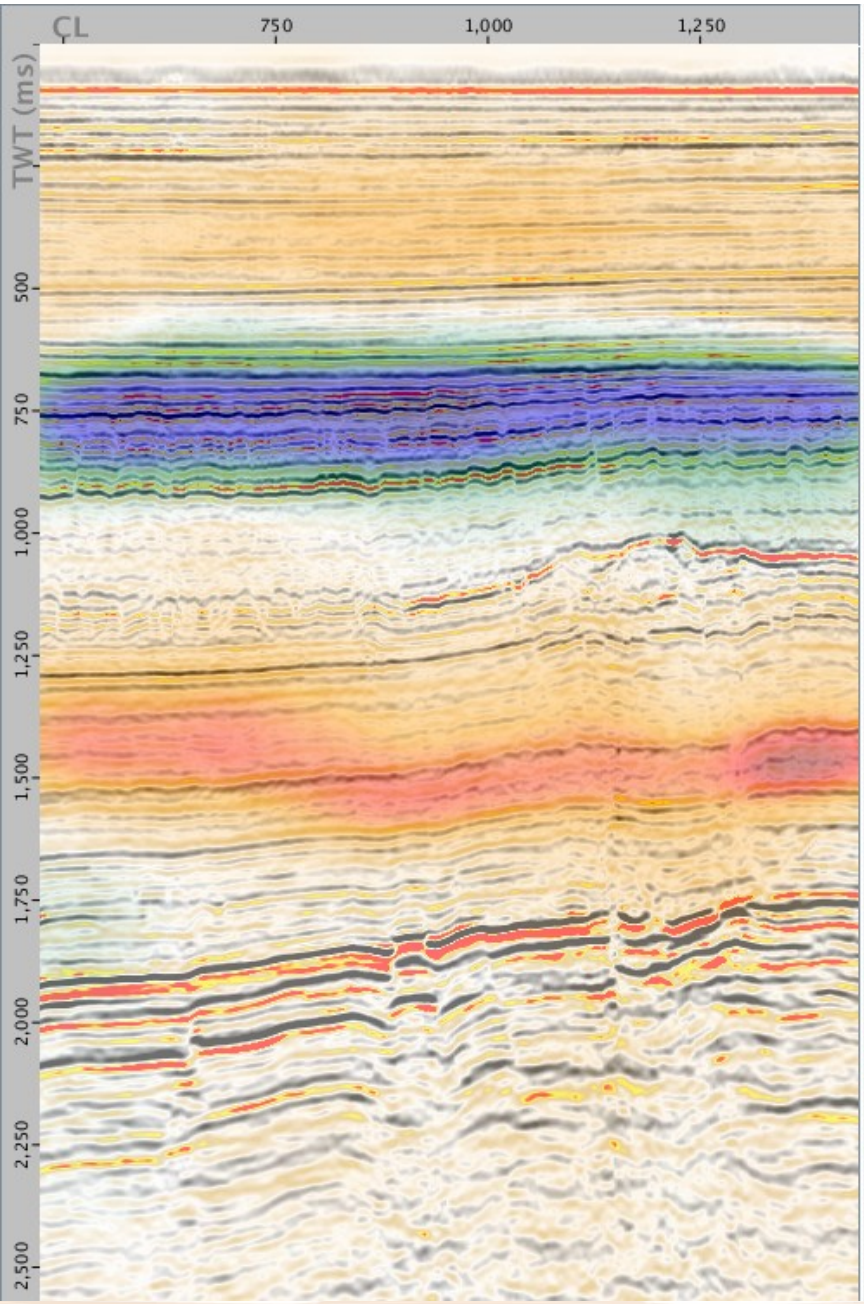


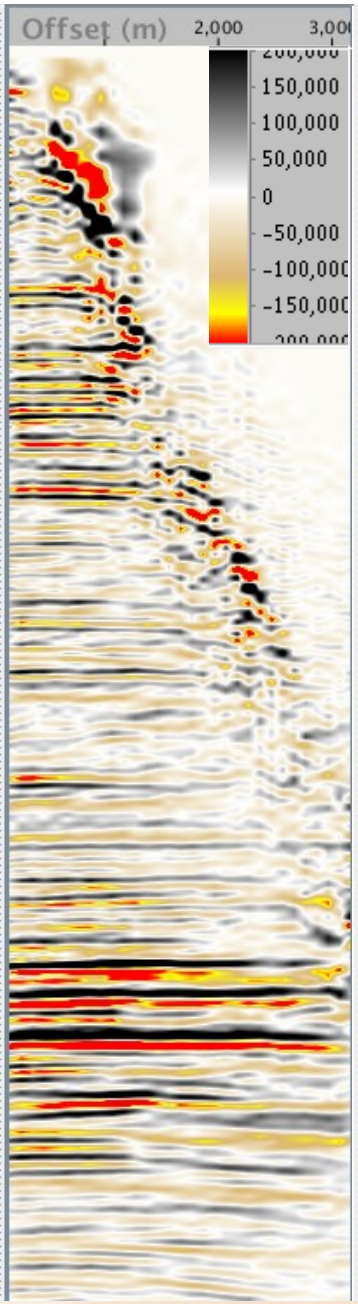


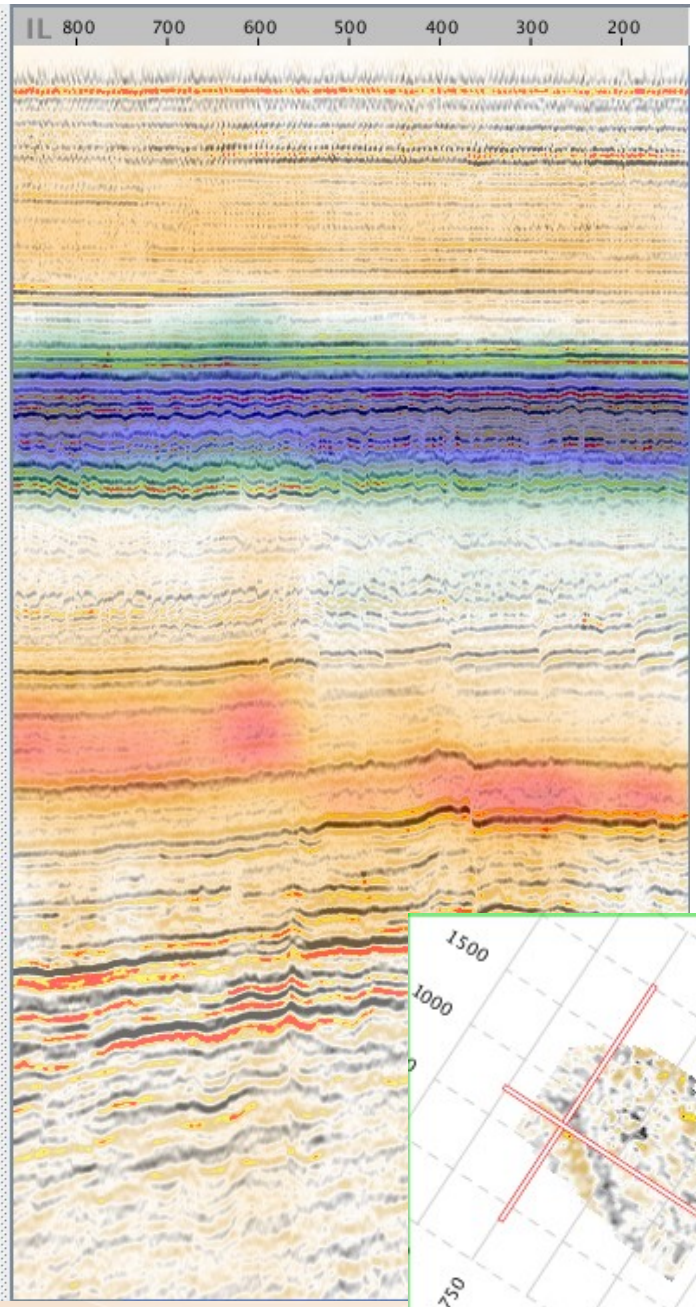
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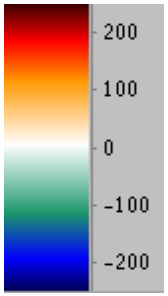
Fixed 2nd Tomography migration gathers & stacks

at IL 741, CL 741 with velocity update (1+2) overlain

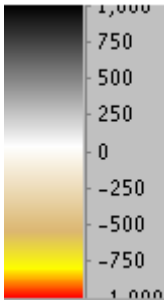








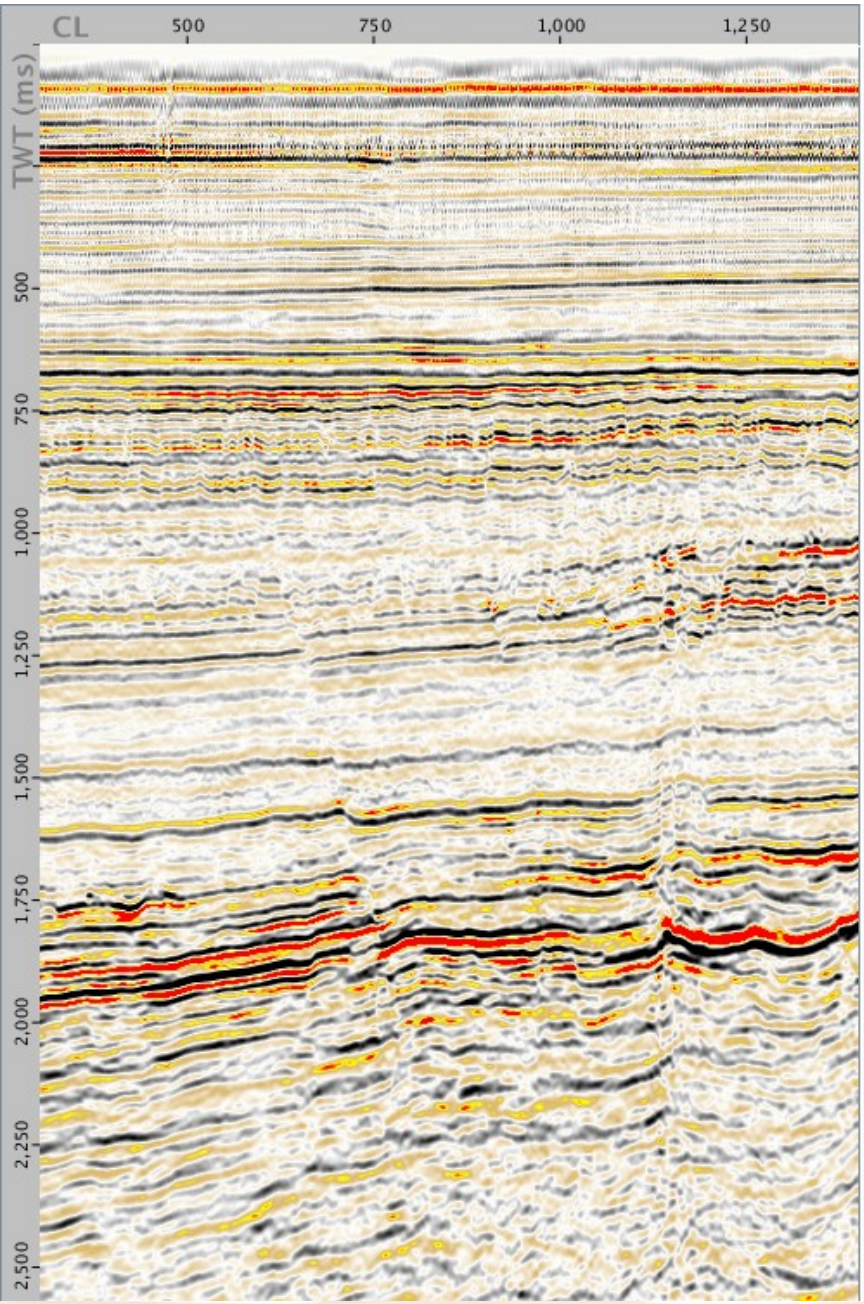
Velocity update colour bar

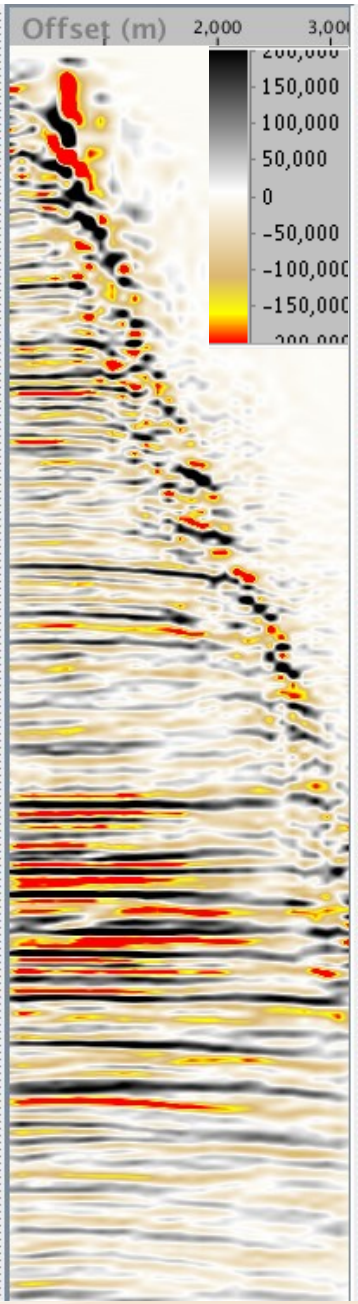


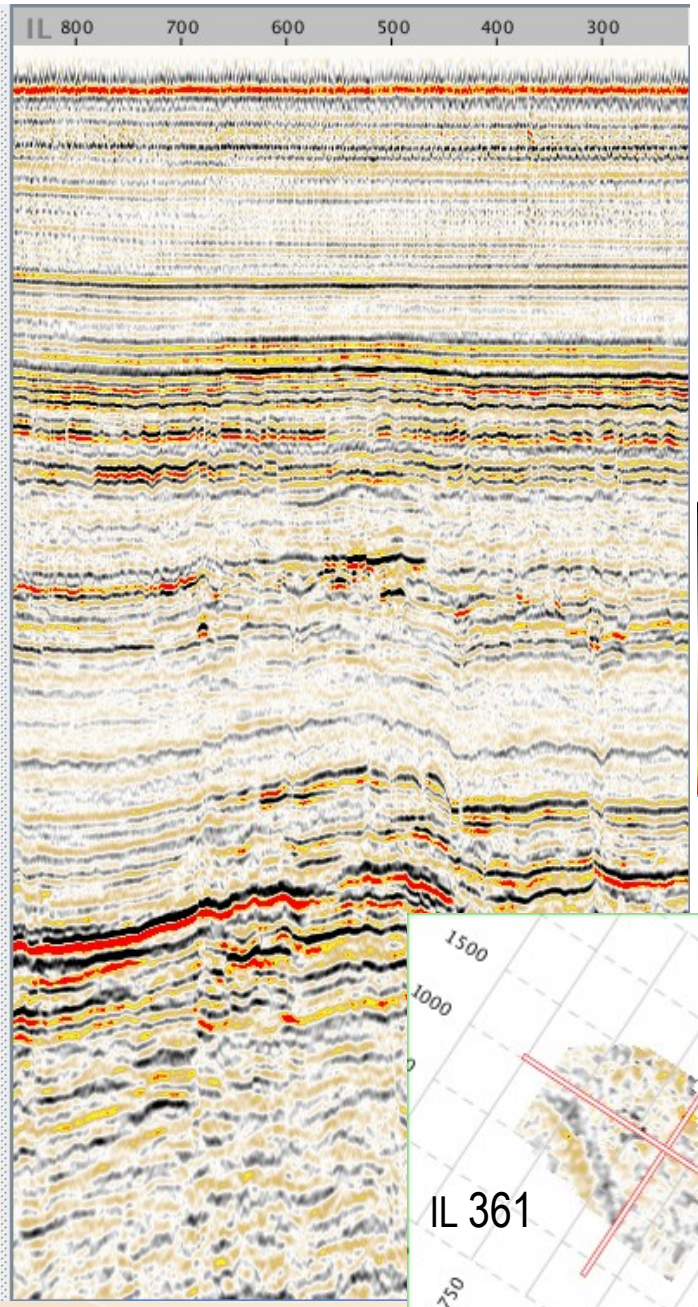
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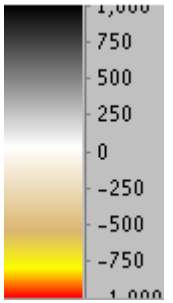
Anisotropic migration gathers and stacks

at IL 361, CL 1021





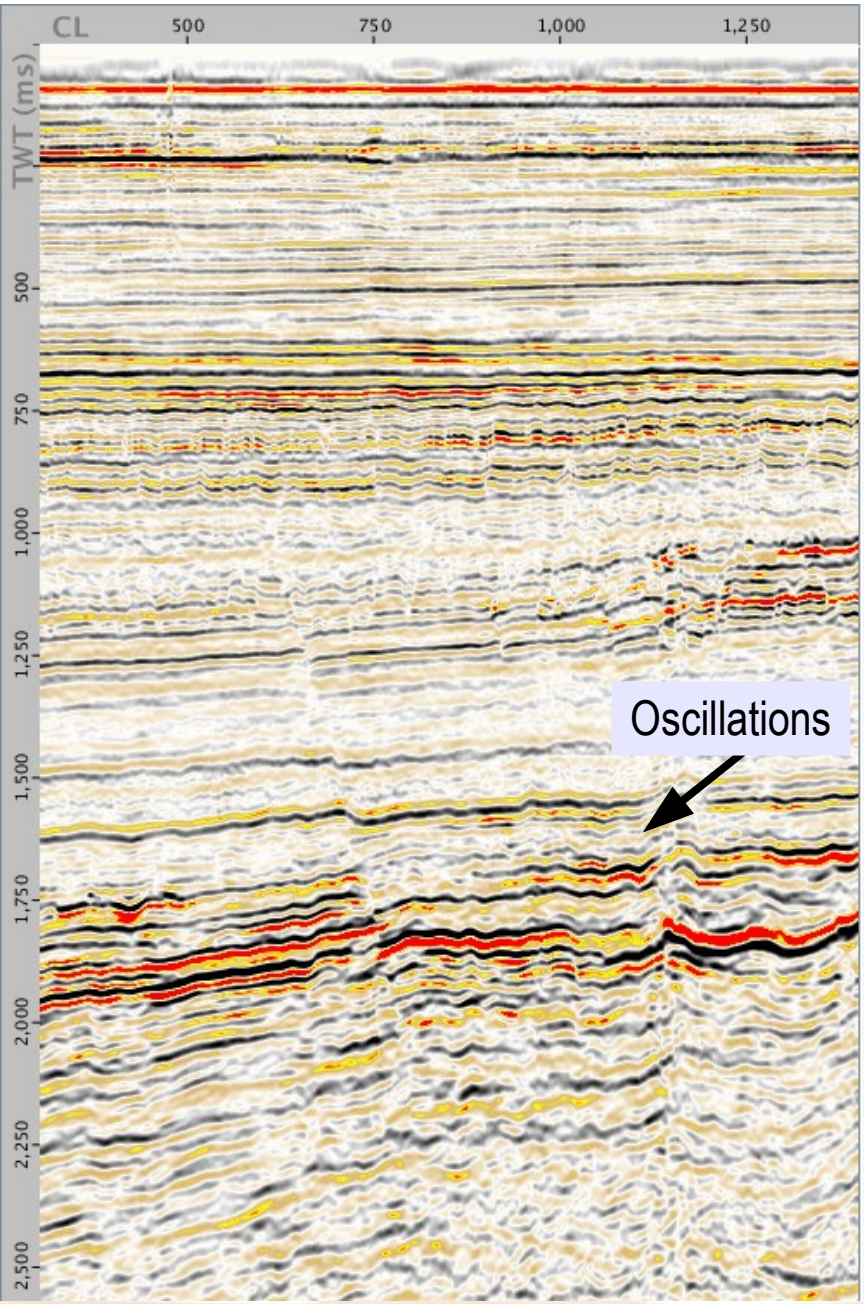


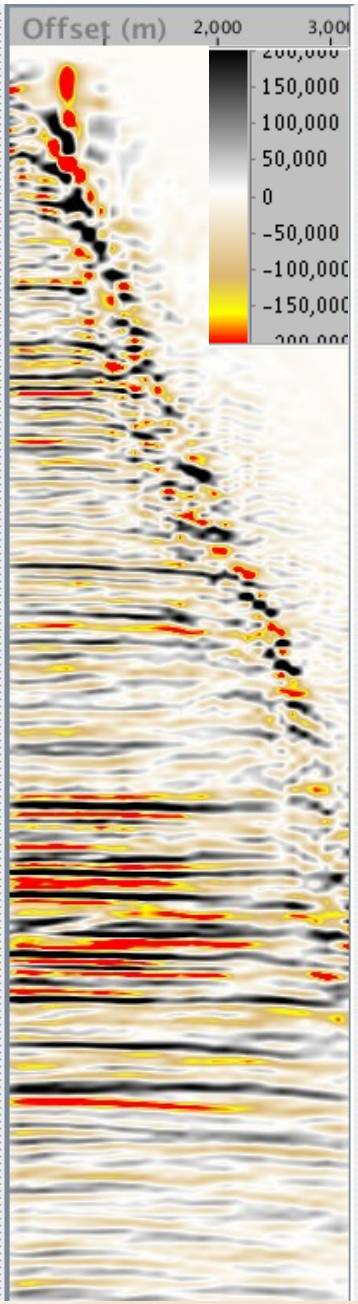


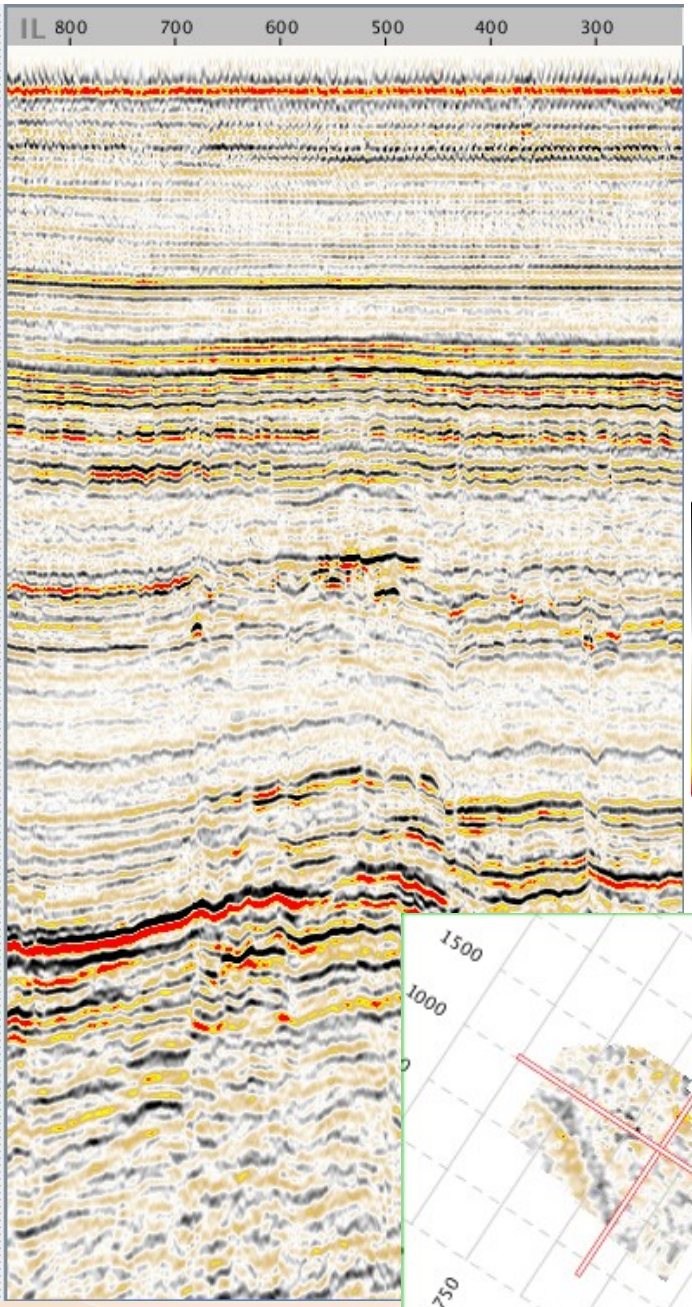
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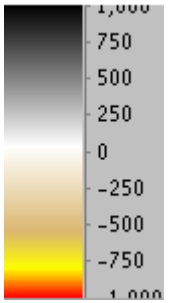
2nd Tomography migration gathers & stacks

at IL 361, CL 1021





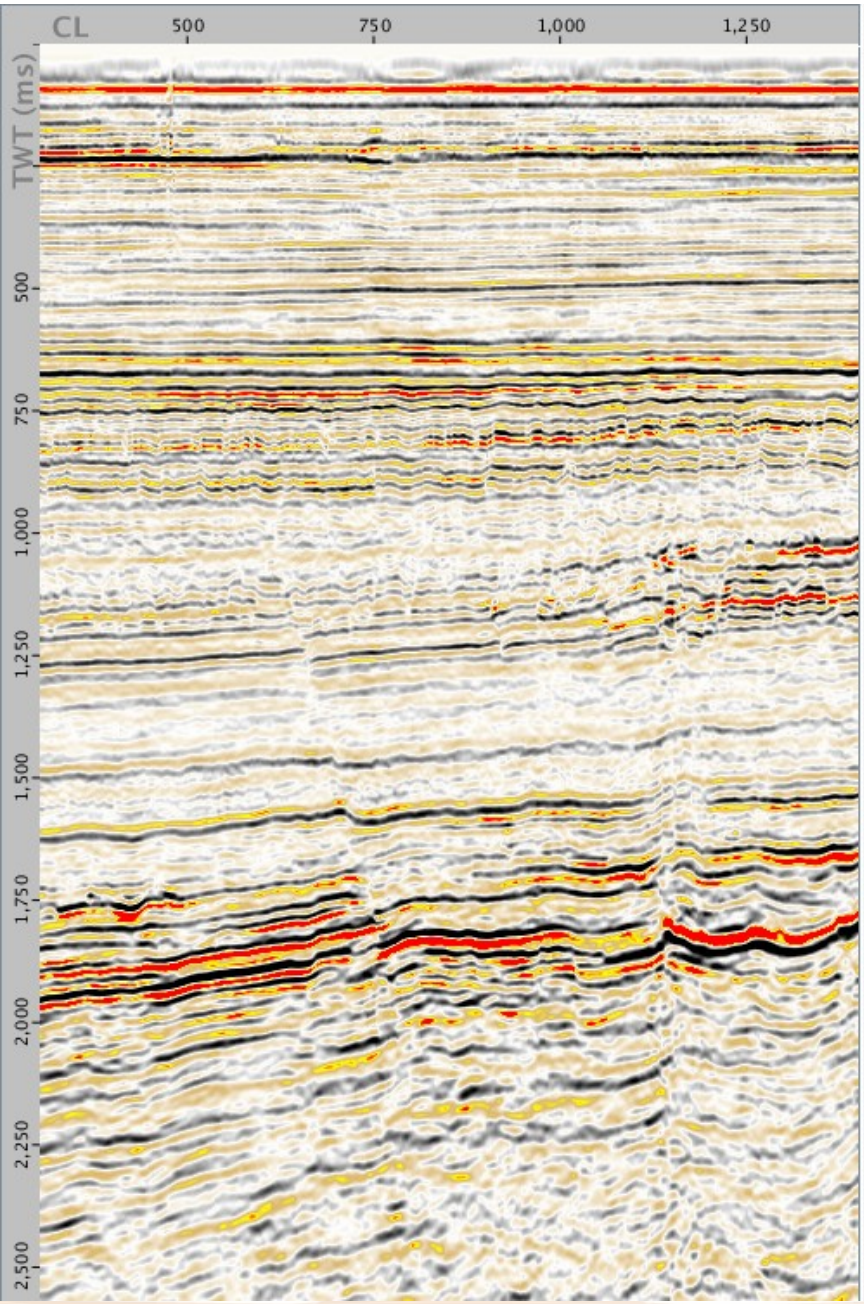


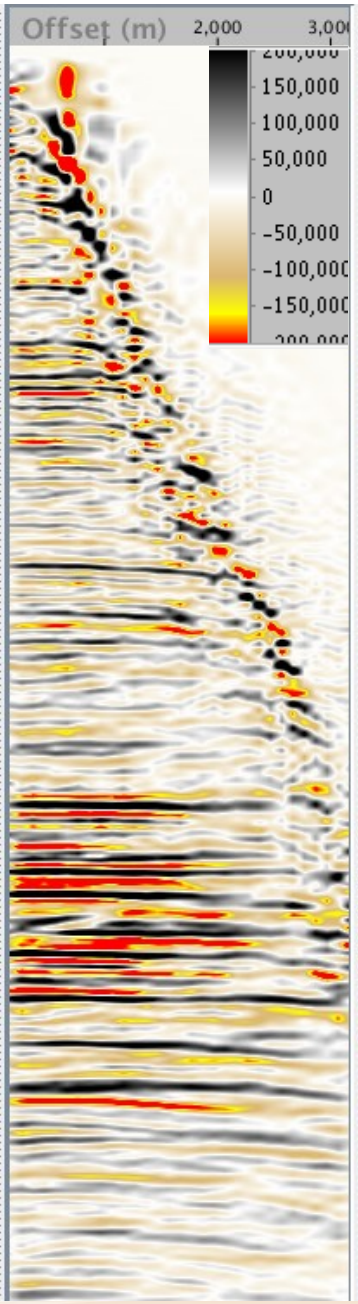


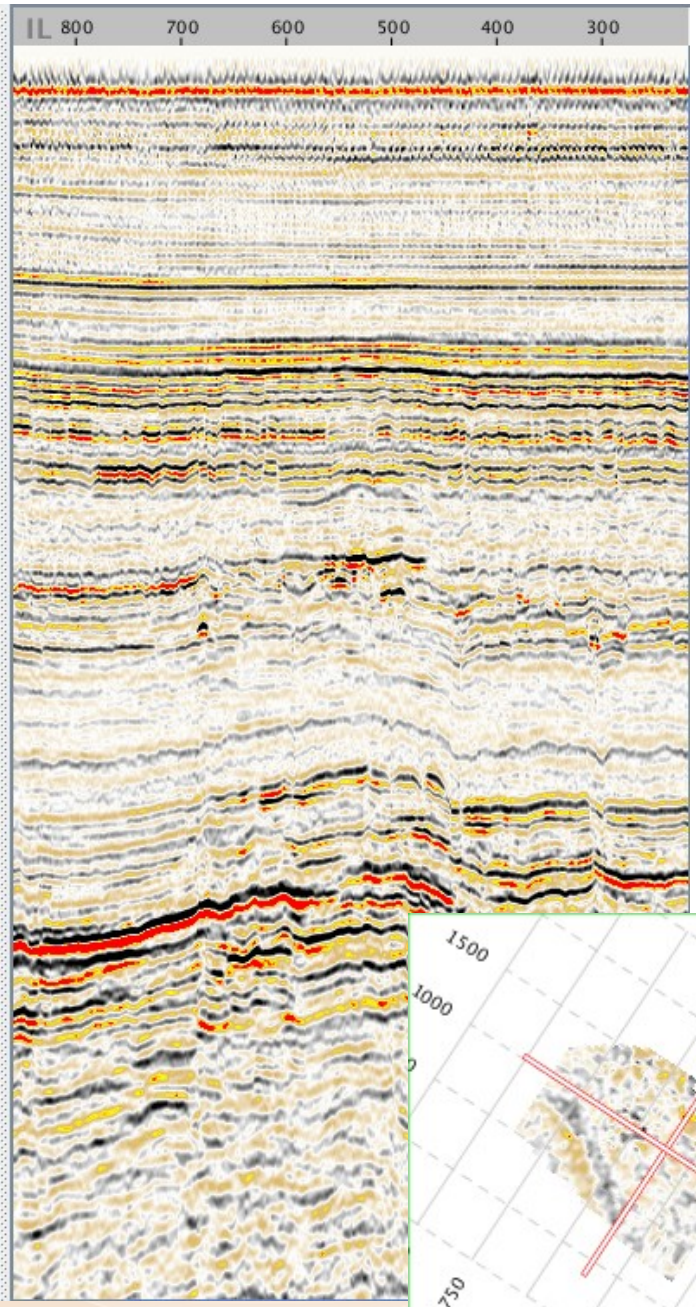
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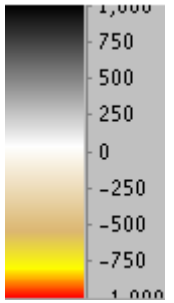
Fixed 2nd Tomography migration gathers & stacks

at IL 361, CL 1021





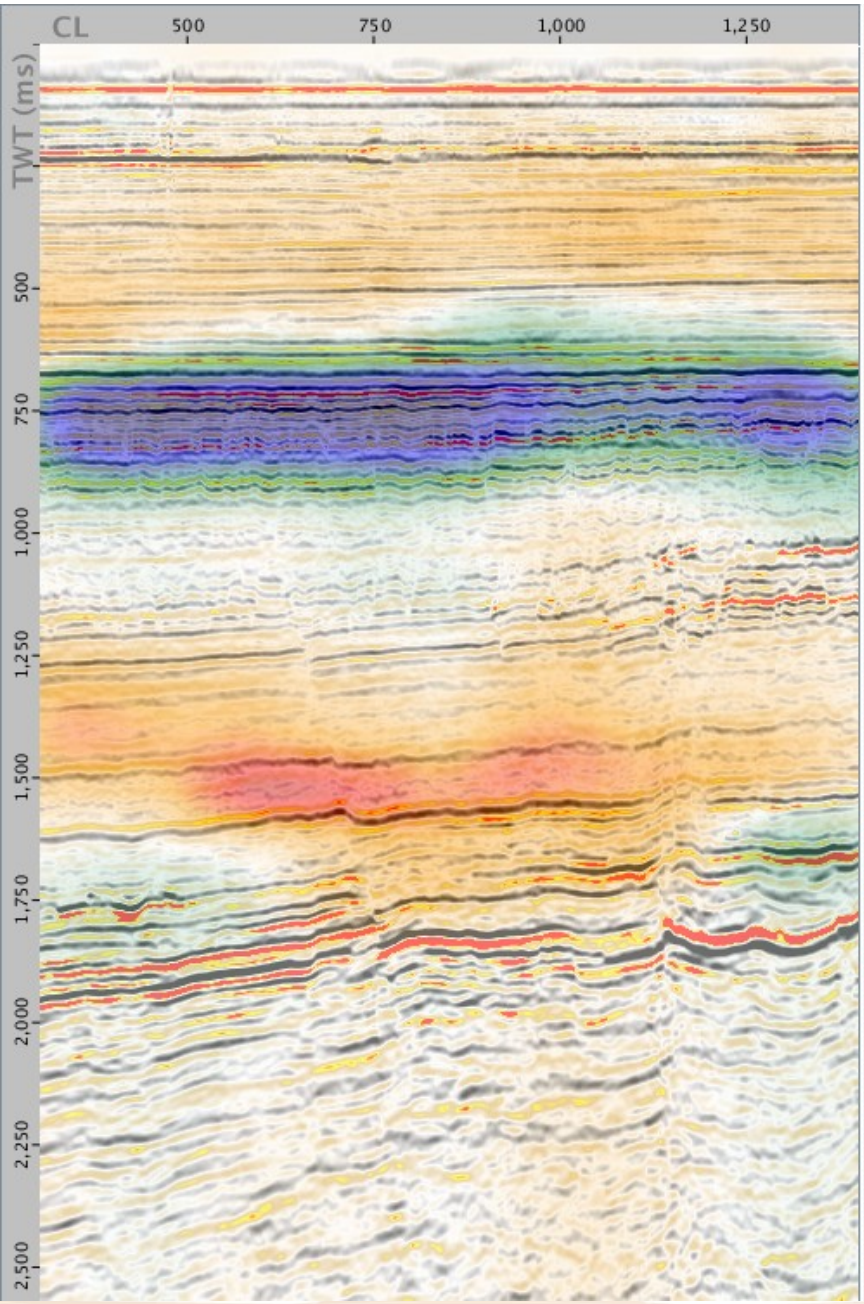


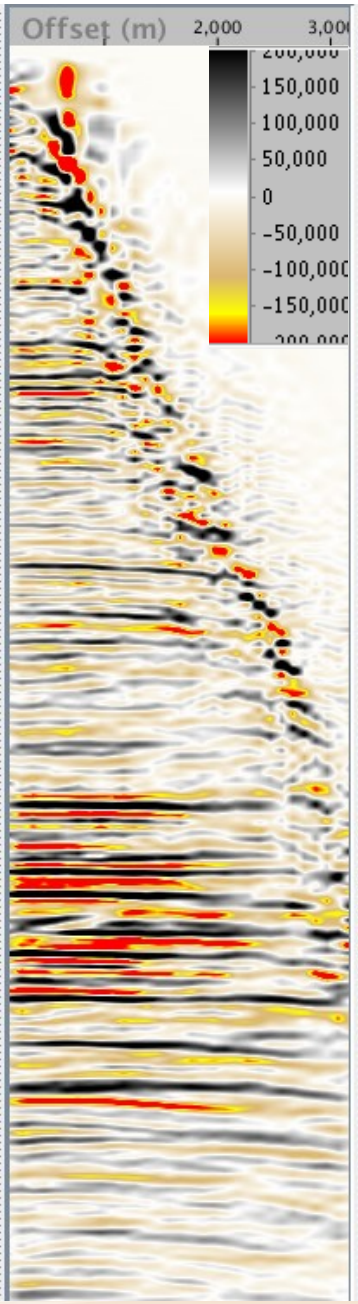


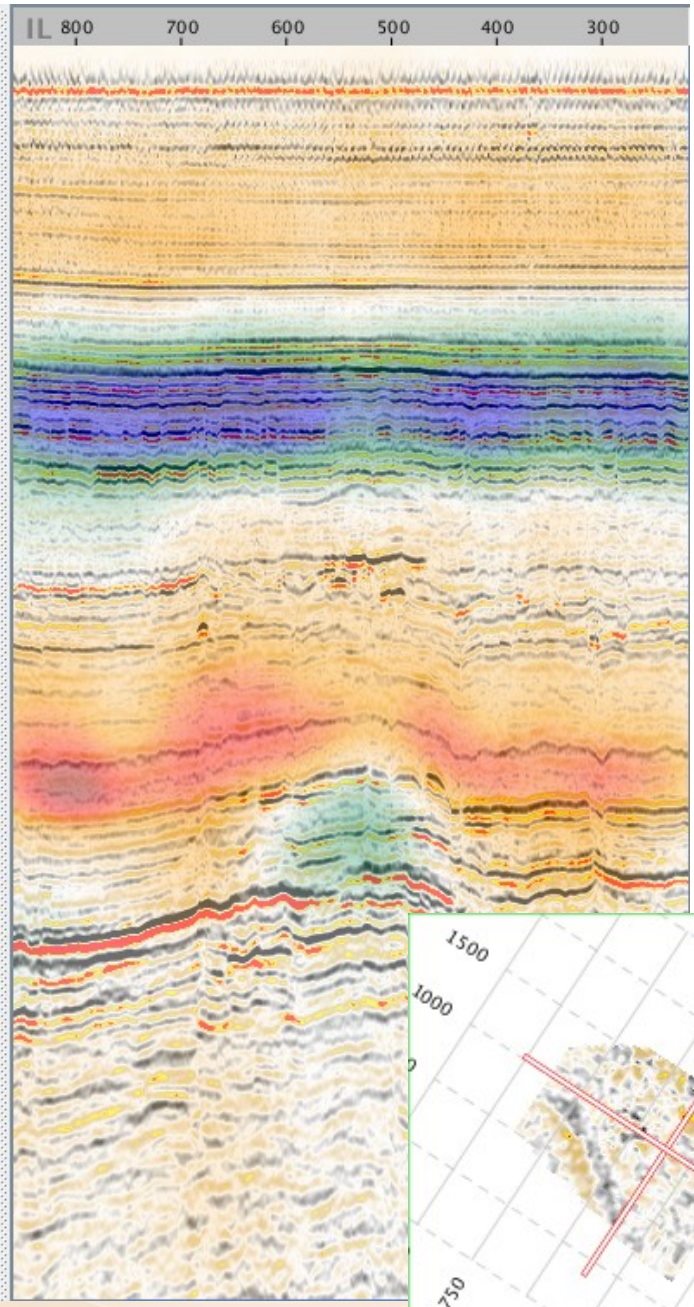
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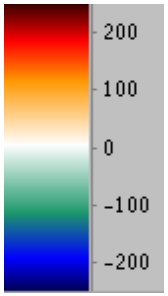
Fixed 2nd Tomography migration gathers & stacks

at IL 361, CL 1021 with velocity update (1+2) overlain

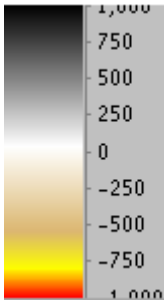








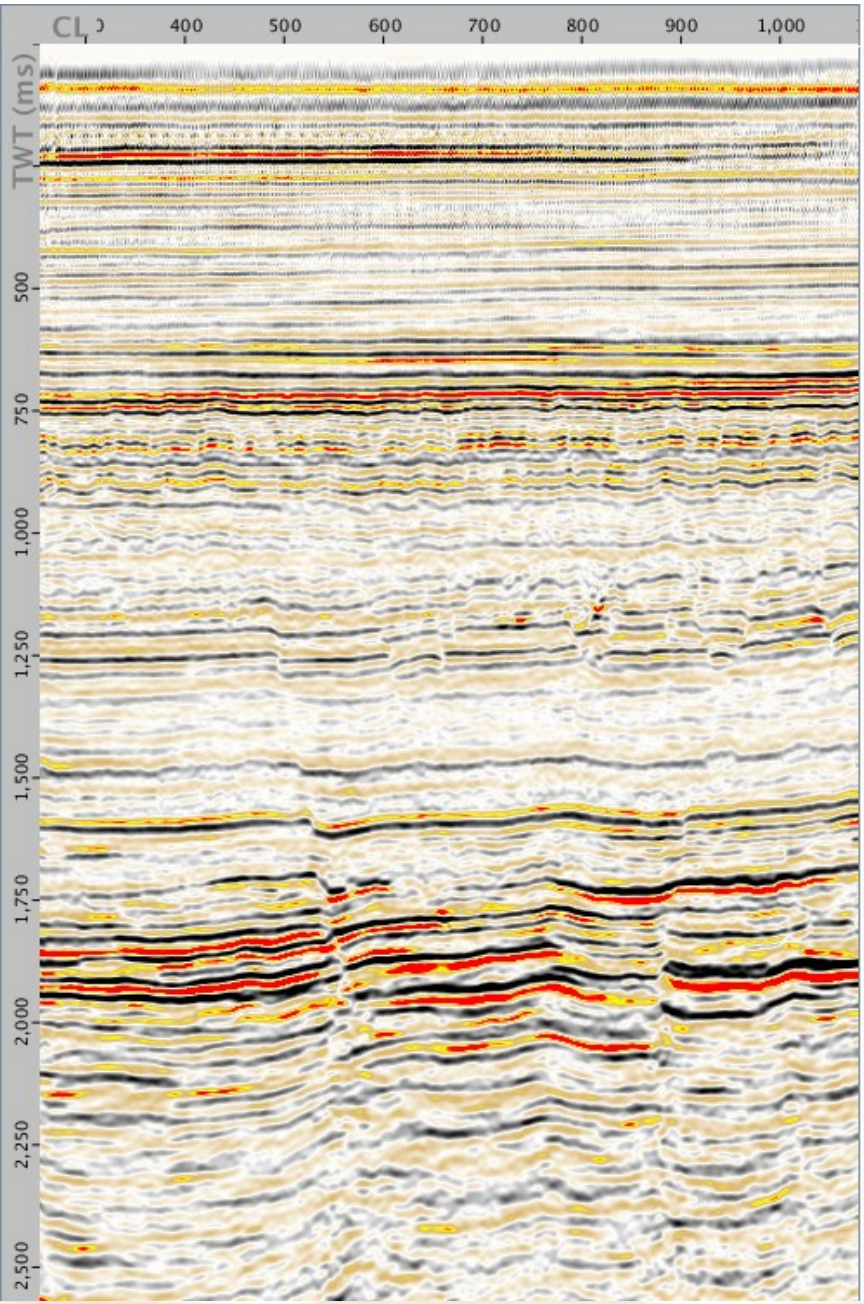
Velocity update colour bar

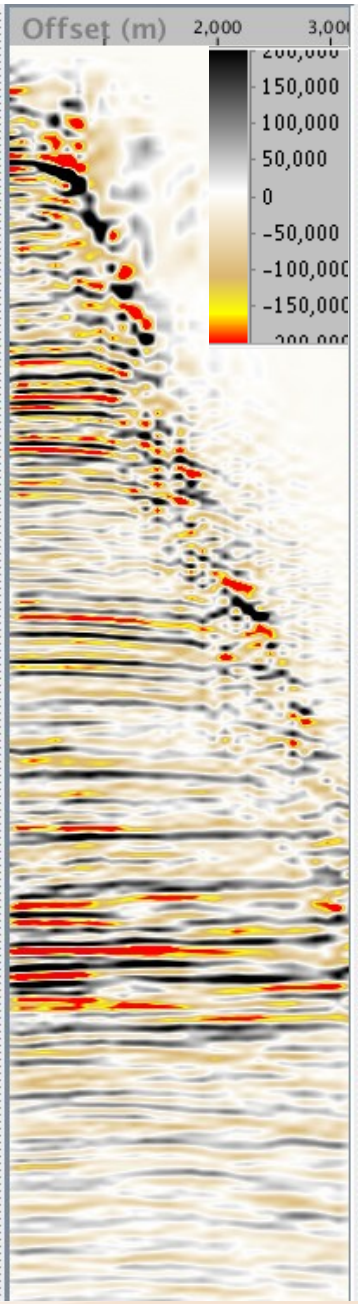


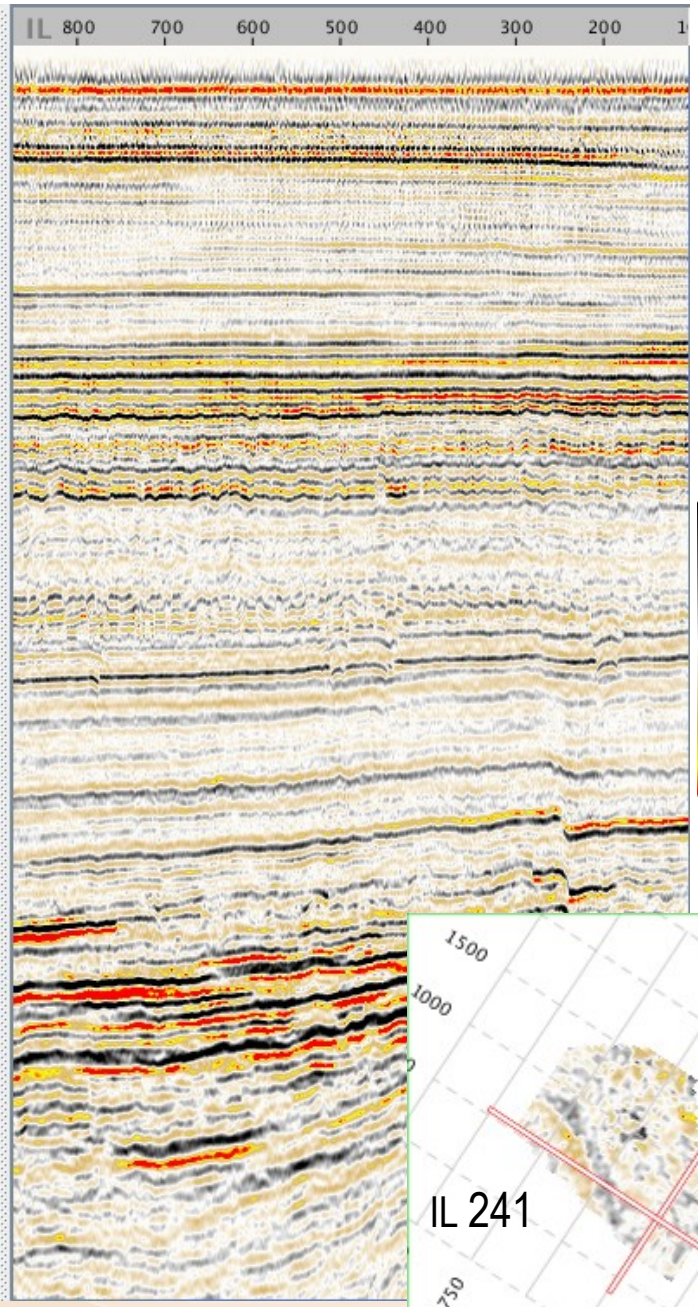
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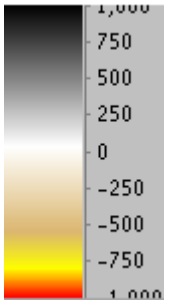
Anisotropic migration gathers and stacks

at IL 241, CL 541





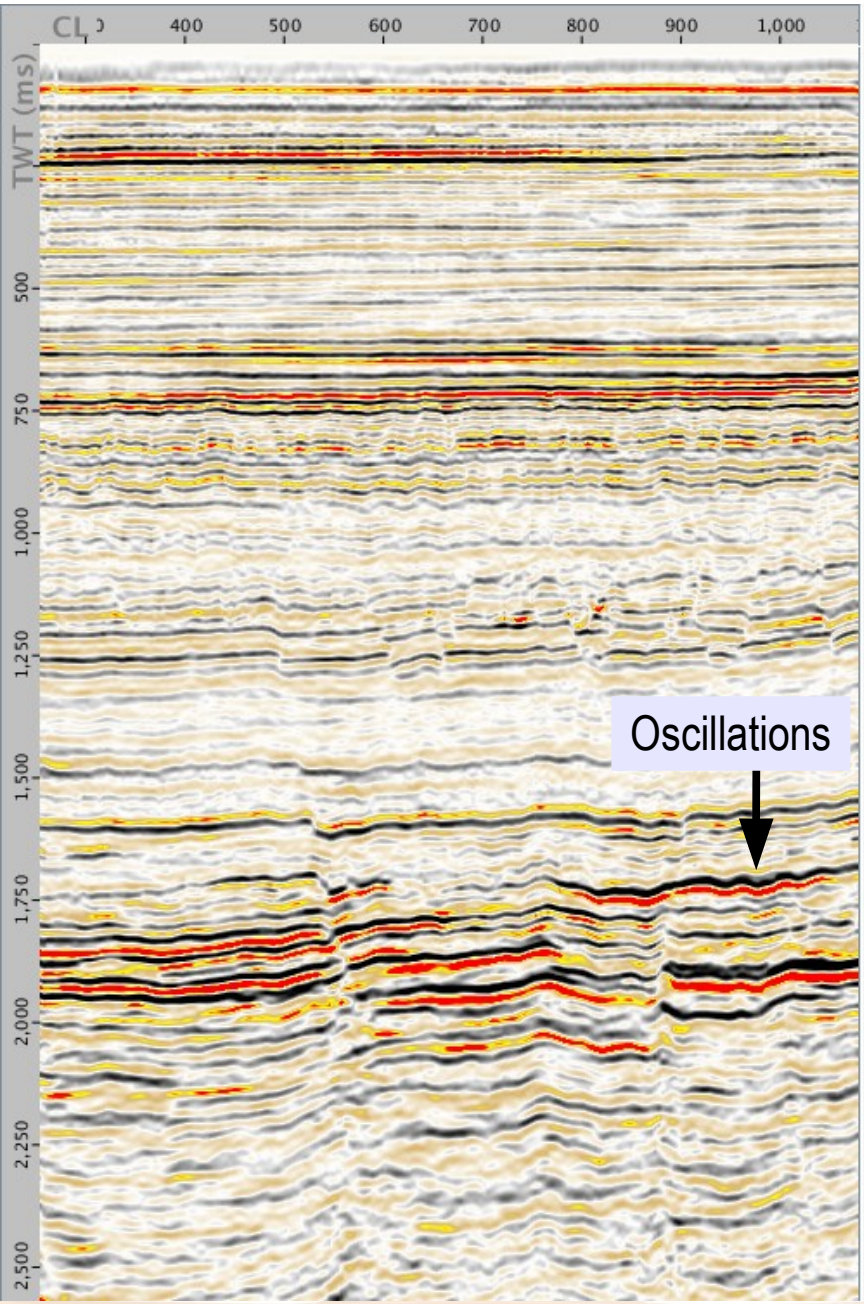


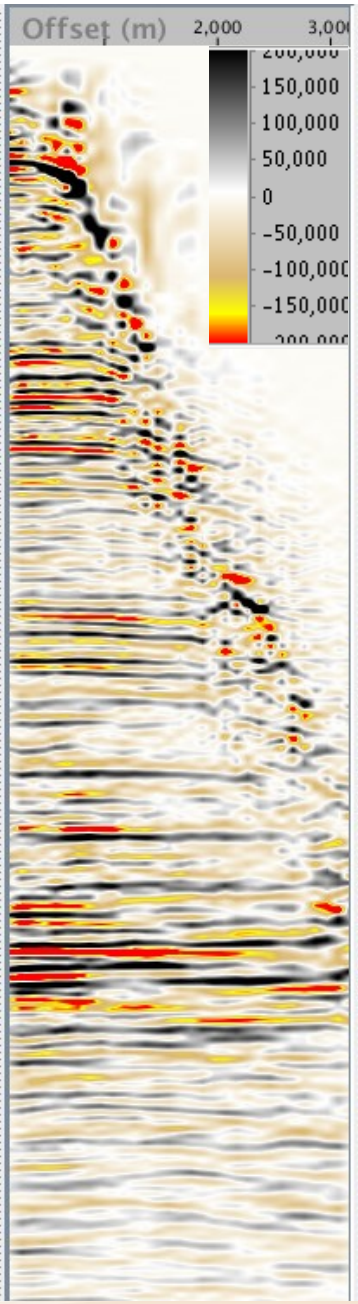


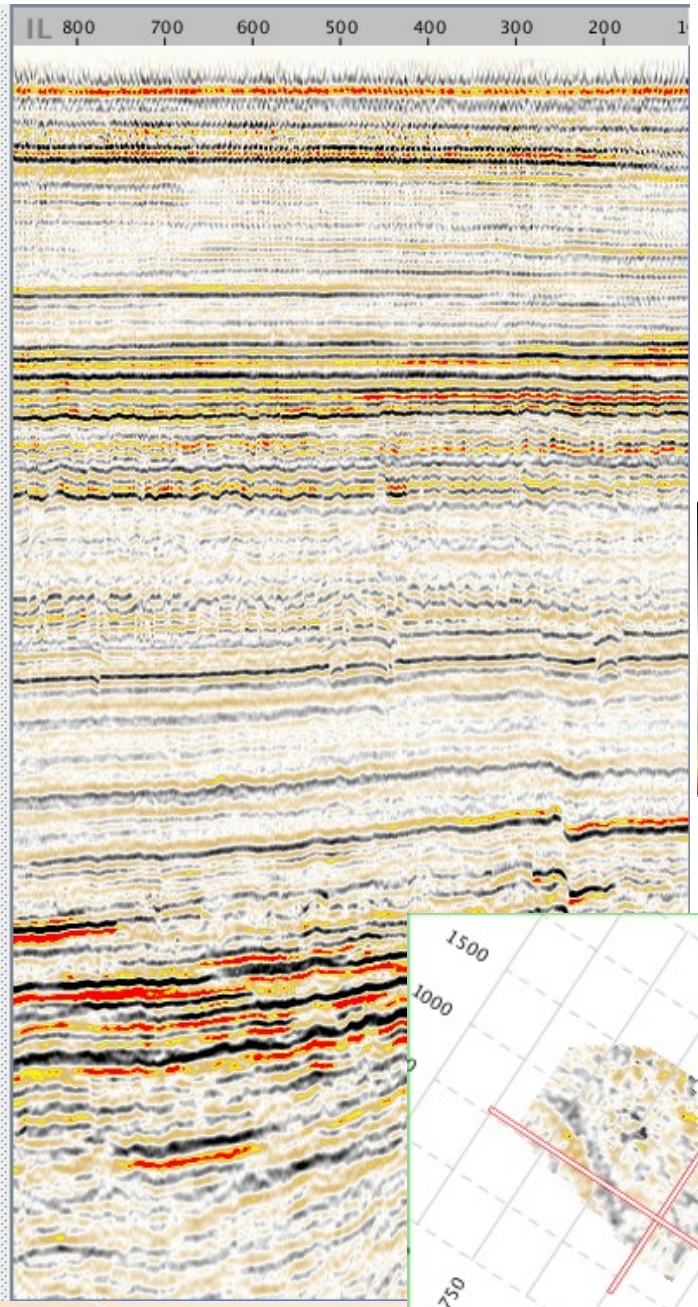
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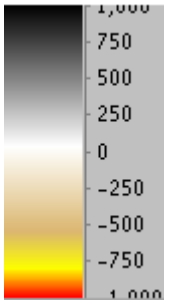
2nd Tomography migration gathers & stacks

at IL 241, CL 541





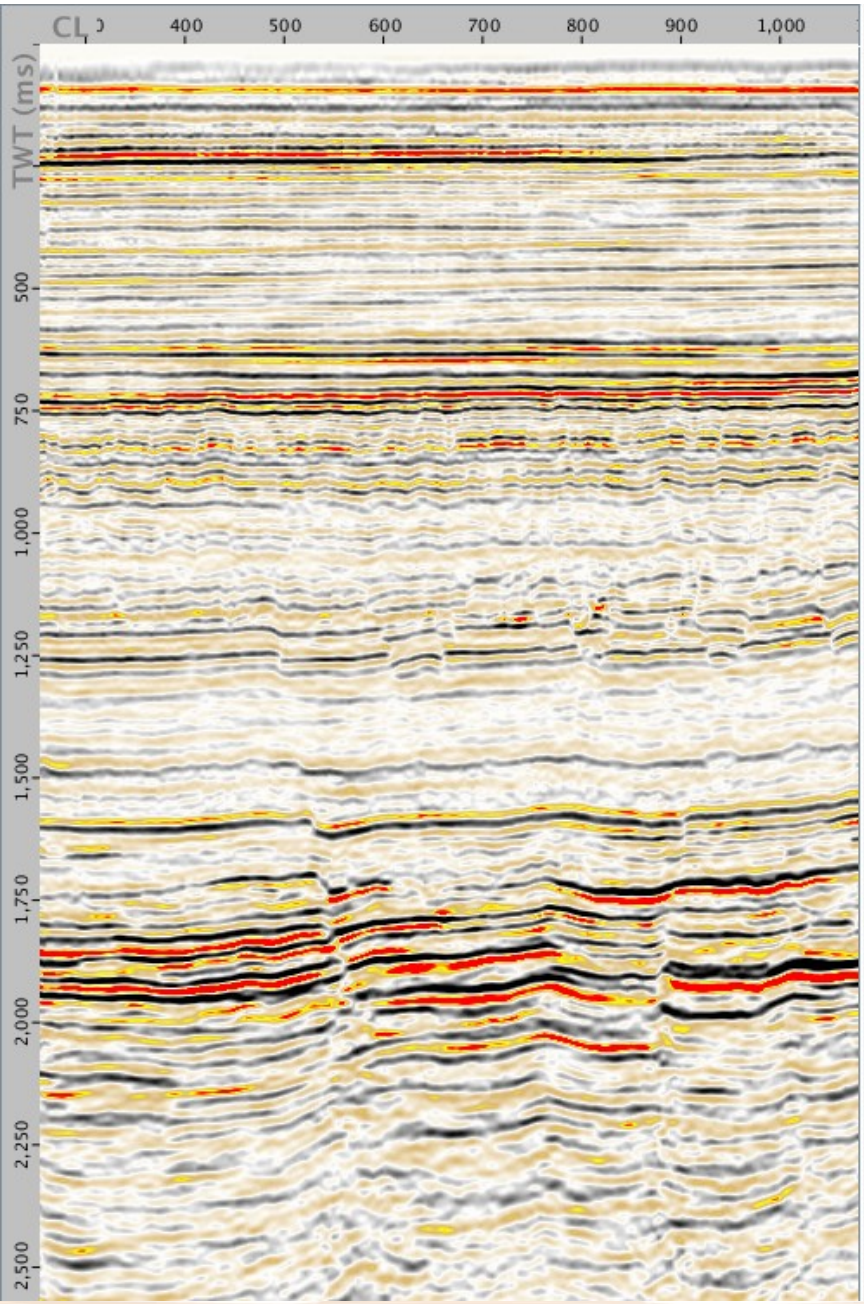


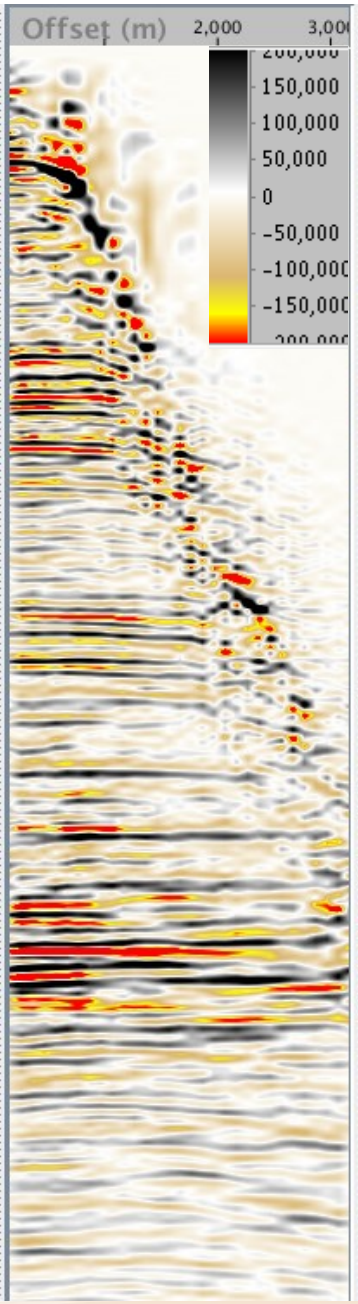


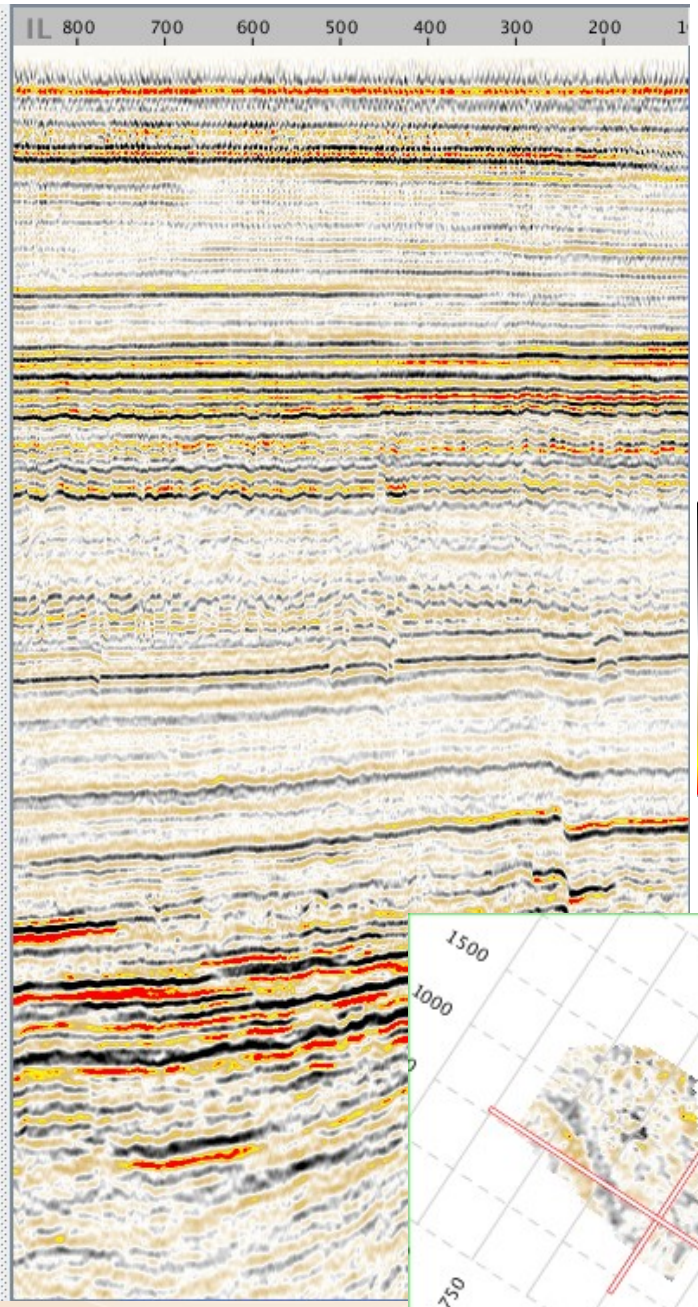
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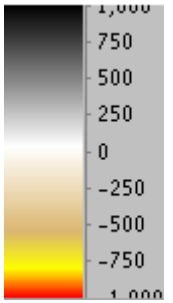
Fixed 2nd Tomography migration gathers & stacks

at IL 241, CL 541





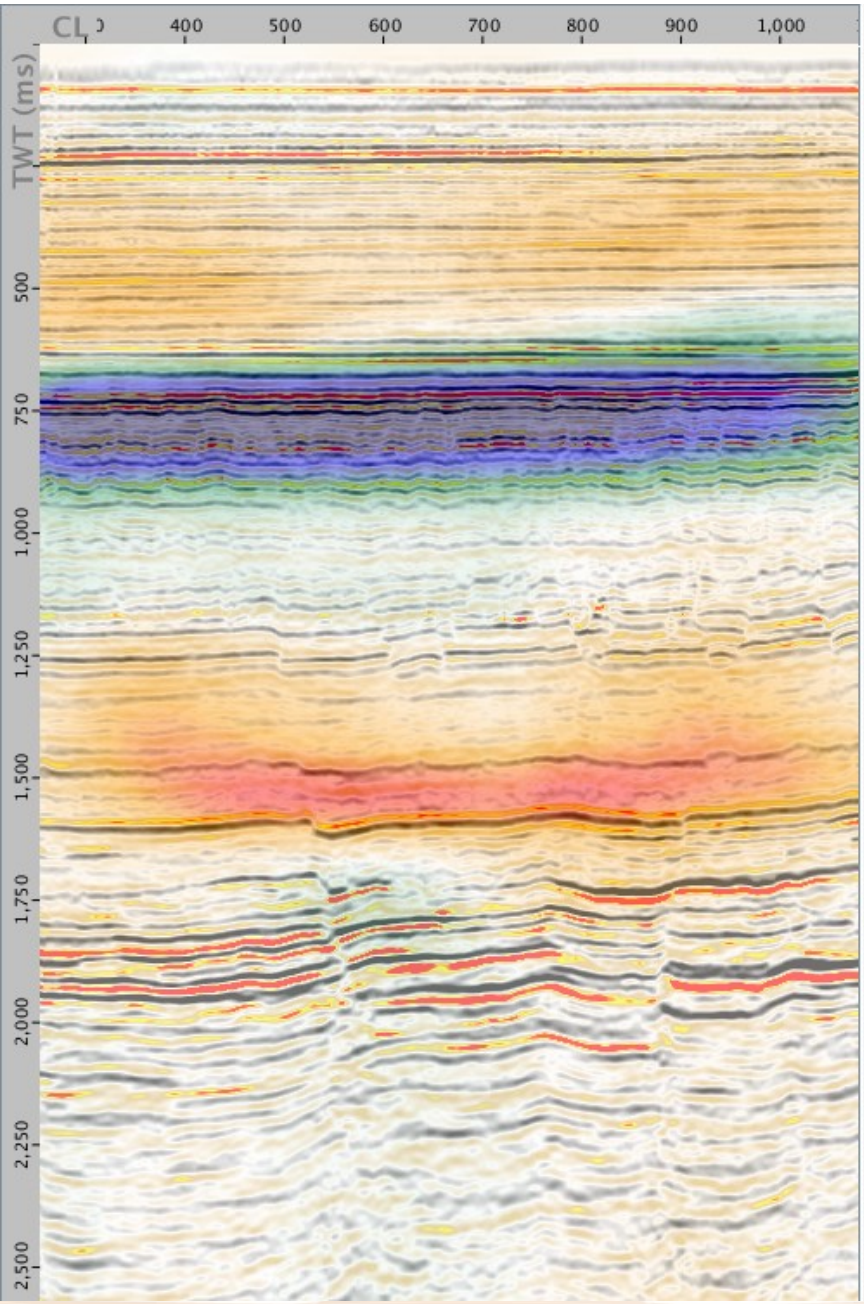


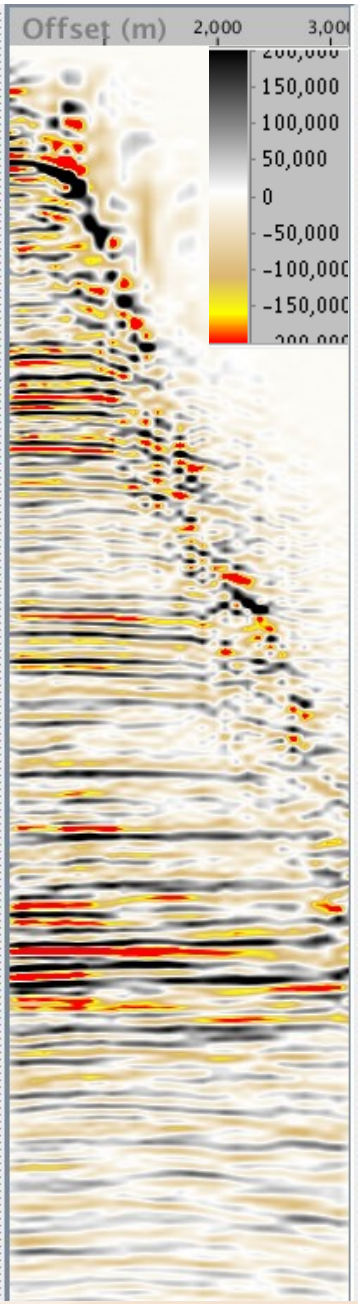


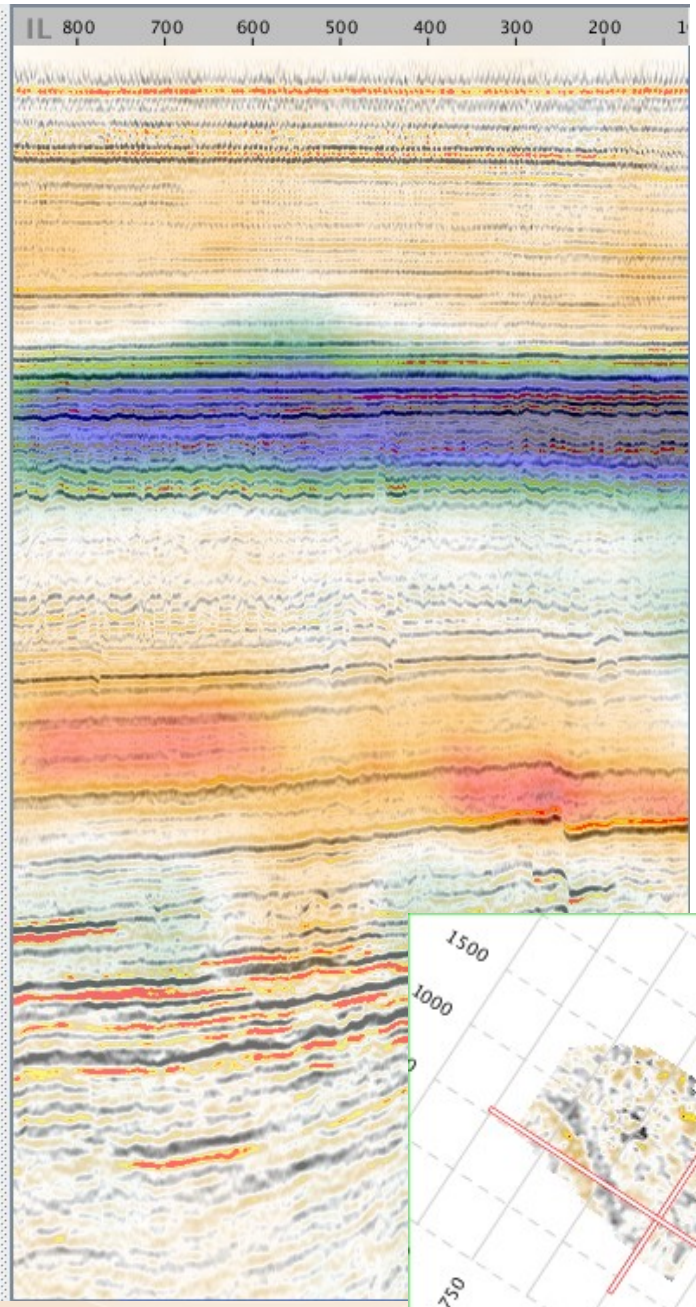
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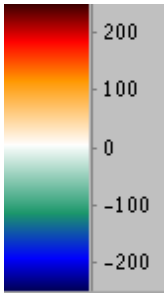
Fixed 2nd Tomography migration gathers & stacks

at IL 241, CL 541 with velocity update (1+2) overlain

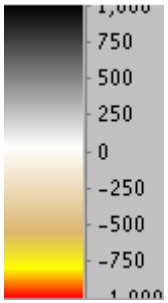








Velocity update colour bar



Stack colour bar

DownUnder GeoSolutions

DUGREG

19th November 2009

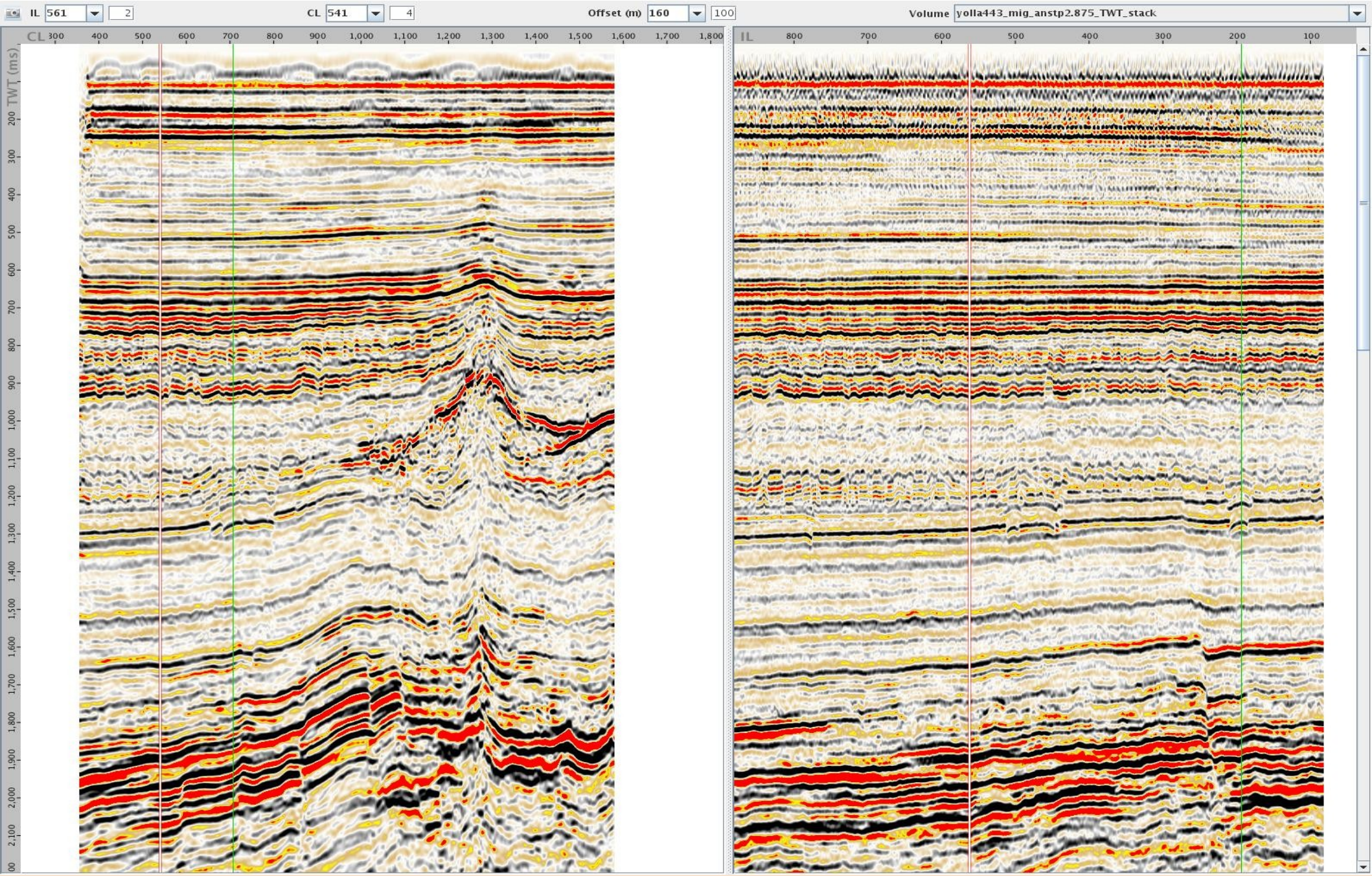
Origin Energy Resources Ltd

Yolla 3D Marine Seismic Survey Reprocessing

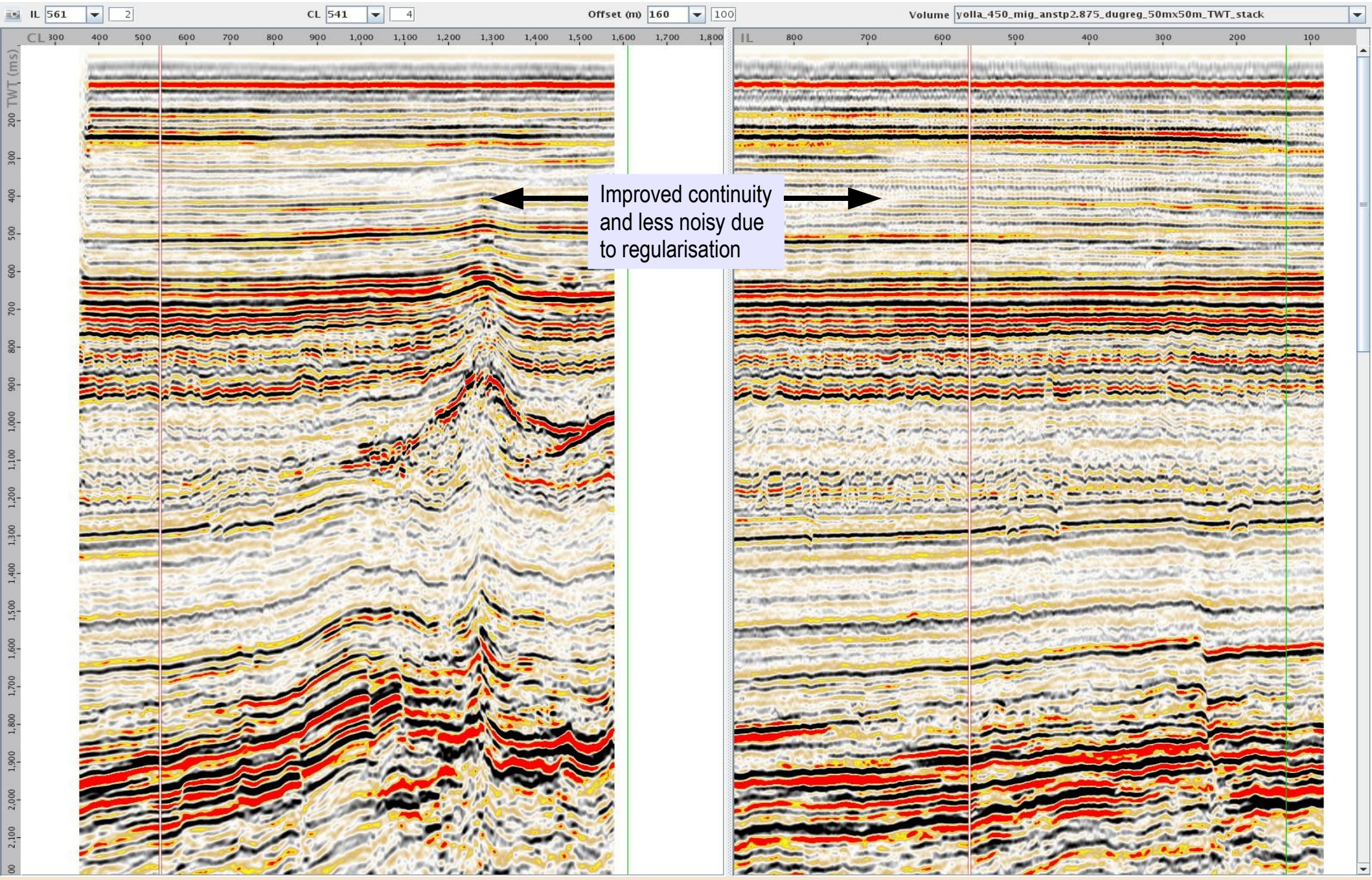
Overview

- Data regularisation (DUGREG) was run for the whole data volume.
  - A comparison of the migrated data using the normal vs DUGREG input is shown in this presentation.
- The DUGREG dataset is used as input to all future migration tests/updates.
- While tomographic velocity updating is in progress, more tests were run to see if the imaging of the structures in the deep could be improved by increasing the velocities even more.
  - A test was run where the velocities in the deep was scaled by 120%. This improved the continuity of the deeper events.

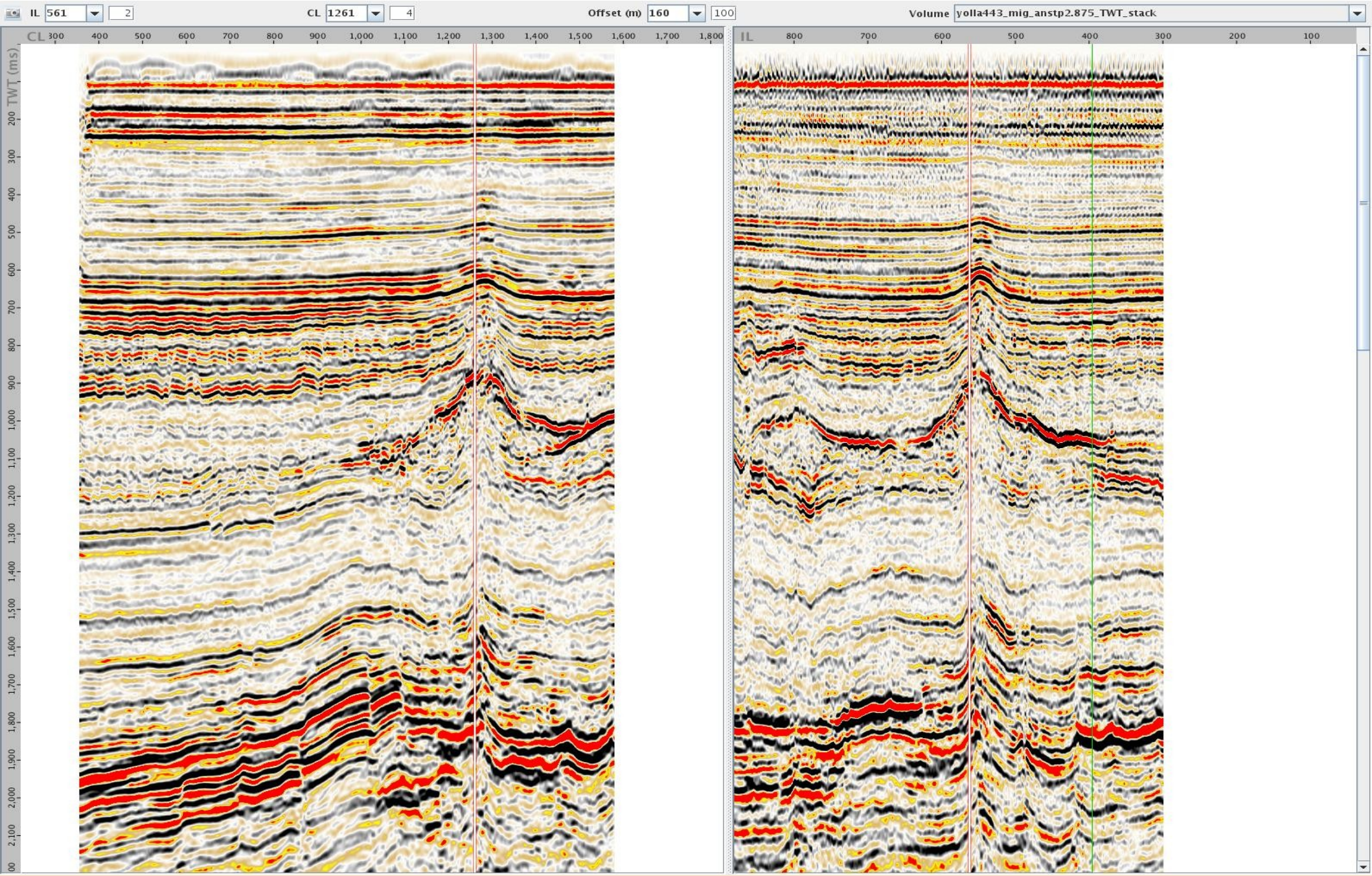
Migration result (No DUGREG)



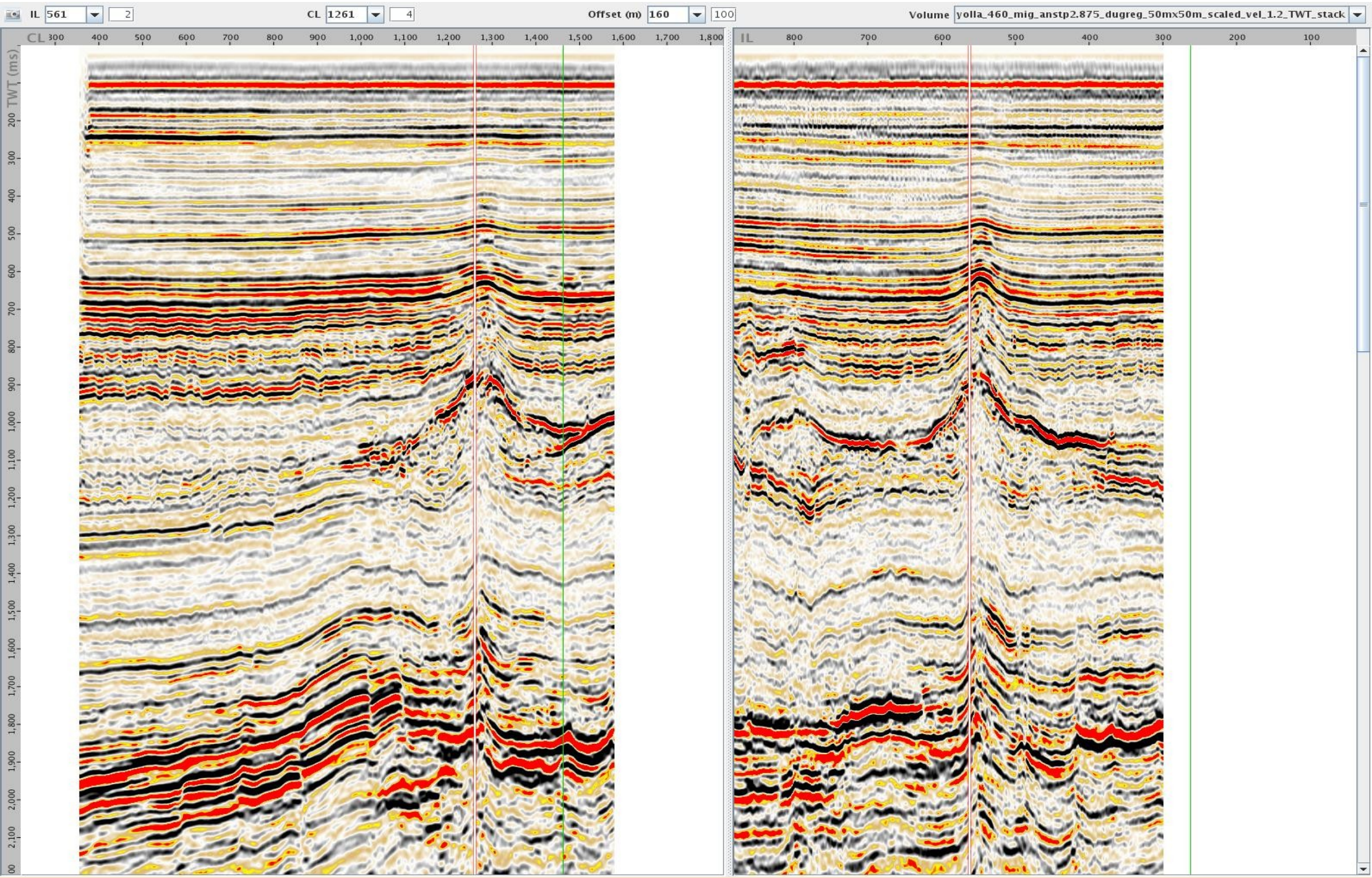
Migration result (DUGREG)



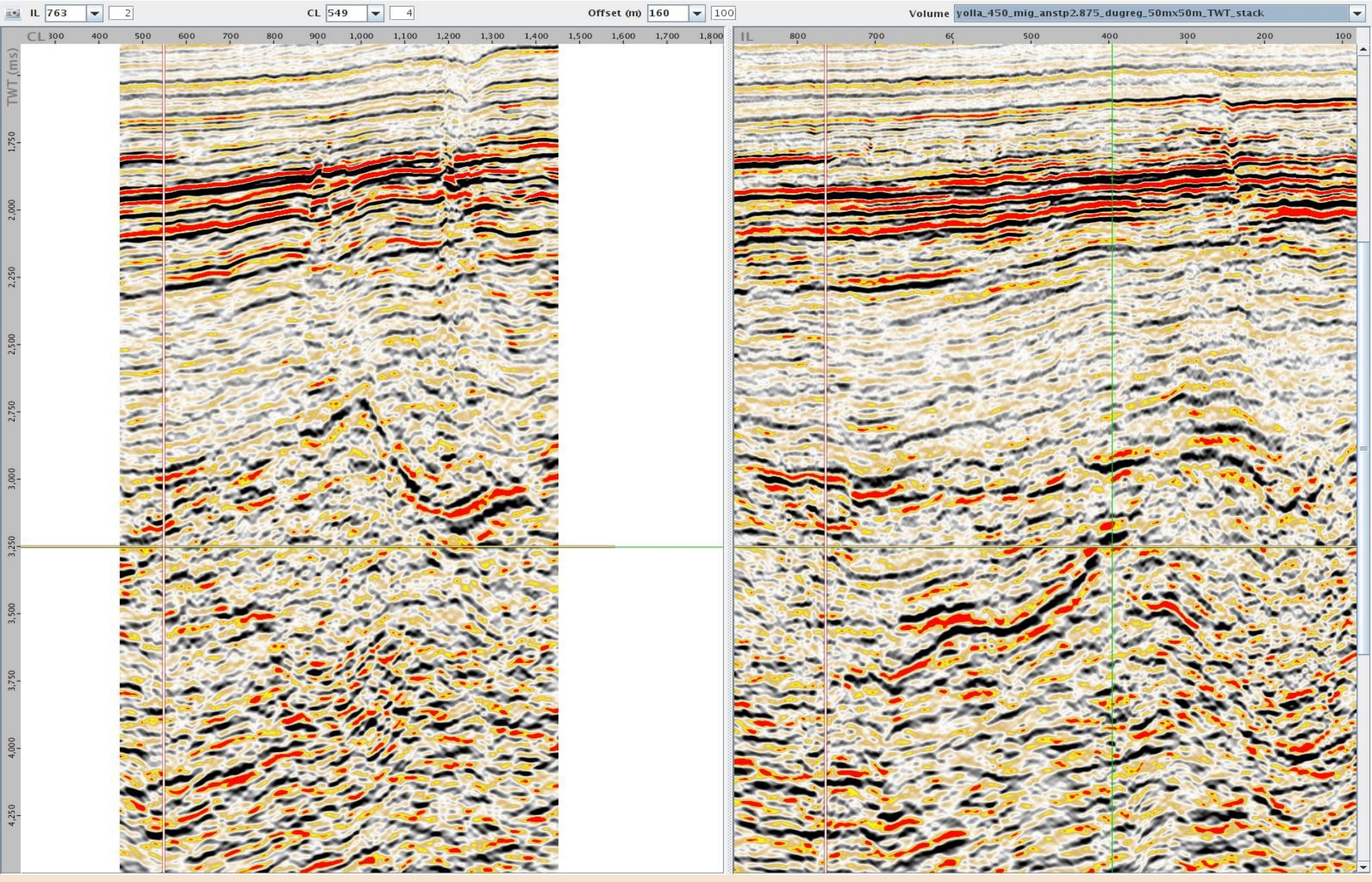
Migration result (No DUGREG)



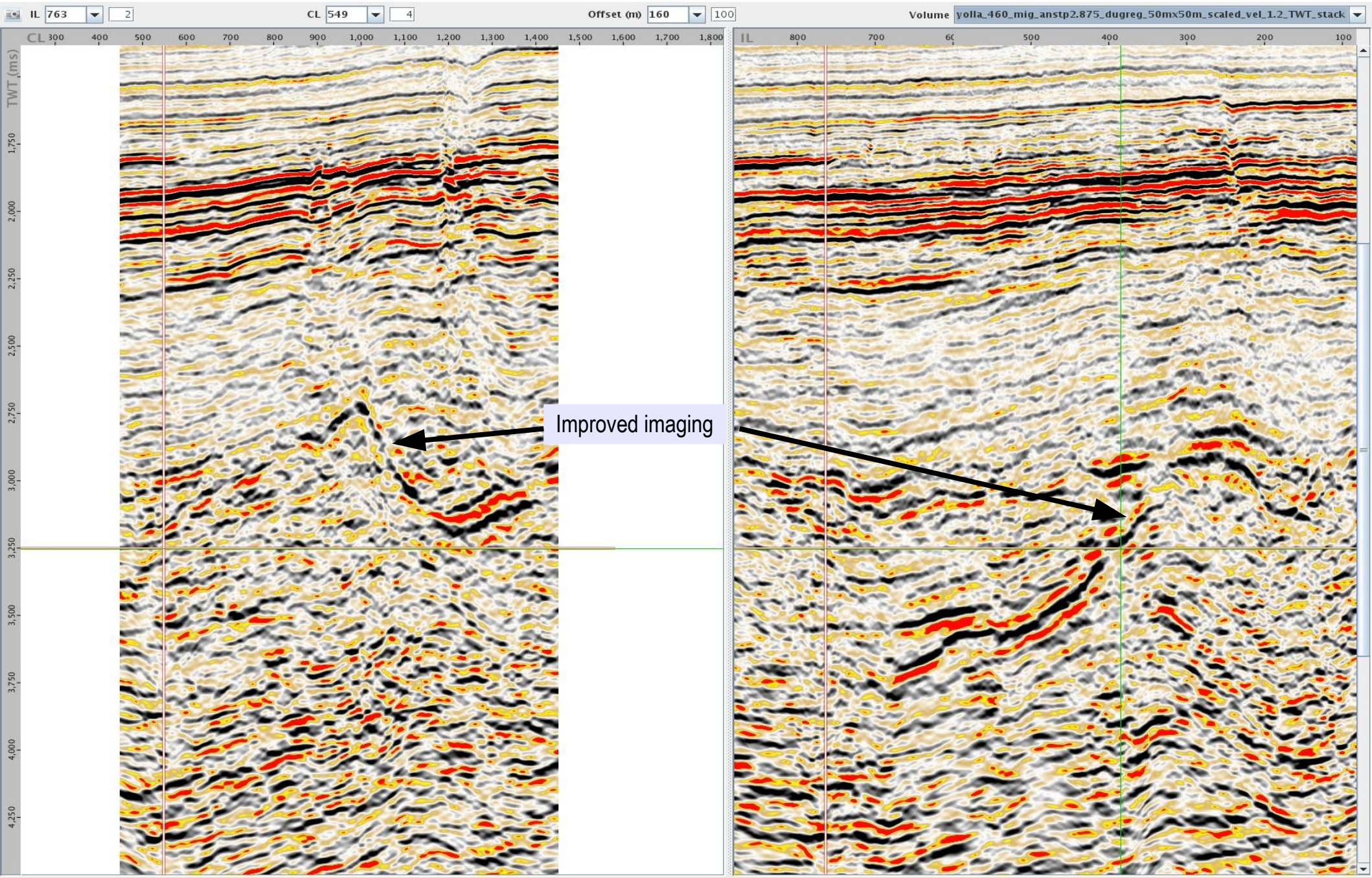
Migration result (DUGREG)



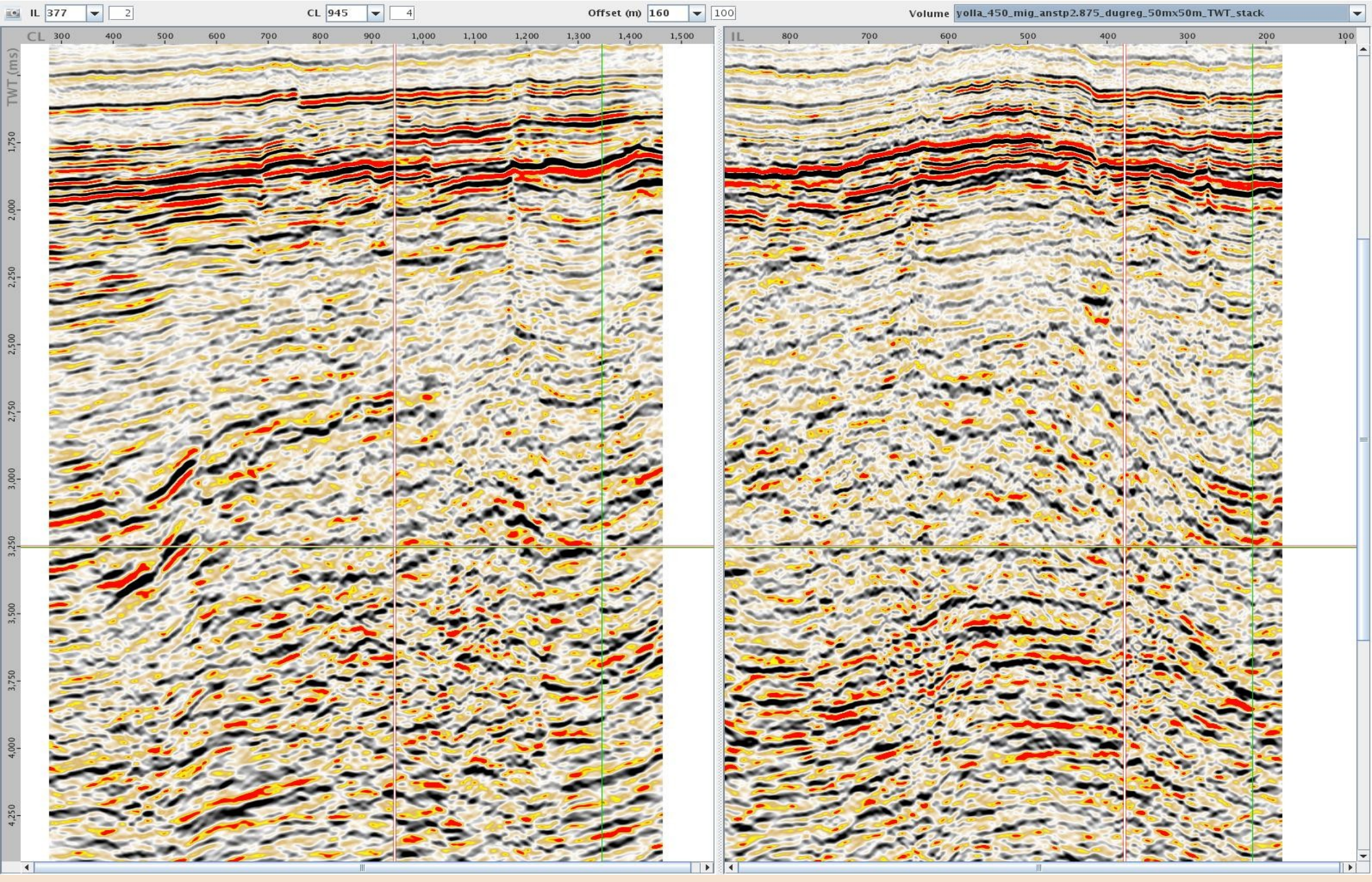
Migration result (velocities scaled by 110%)



Migration result (velocities scaled by 120%)



Migration result (velocities scaled by 110%)



Migration result (velocities scaled by 120%)

